

# Chapter 2 Part E 4.3L V6 engine

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2E

## Specifications

### General

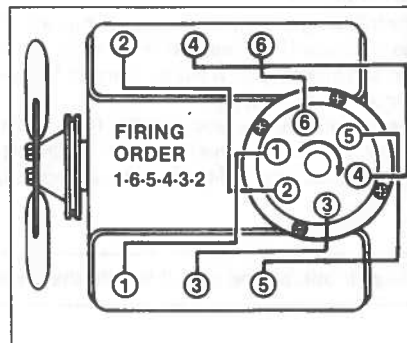
|                                  |                  |
|----------------------------------|------------------|
| Cylinder numbers (front-to-rear) |                  |
| Left (driver's) side .....       | 1-3-5            |
| Right side .....                 | 2-4-6            |
| Firing order .....               | 1-6-5-4-3-2      |
| Displacement .....               | 262 cubic inches |

### Camshaft

|                                              |                         |
|----------------------------------------------|-------------------------|
| Bearing journal                              |                         |
| Diameter .....                               | 1.8682 to 1.8692 inches |
| Out-of-round limit .....                     | 0.001 inch              |
| Lobe lift                                    |                         |
| Intake .....                                 | 0.357 inch              |
| Exhaust .....                                | 0.390 inch              |
| Endplay .....                                | 0.004 to 0.012 inch     |
| Balancer shaft (1992 and later VIN W engine) |                         |
| Rear bearing journal outside diameter .....  | 1.4309 to 1.4215 in     |

### Torque specifications

|                               |                                            |
|-------------------------------|--------------------------------------------|
|                               | <b>Ft-lbs (unless otherwise indicated)</b> |
| Valve cover bolts .....       | 90 in-lbs                                  |
| Intake manifold bolts         |                                            |
| TBI models .....              | 36                                         |
| CPI models                    |                                            |
| Initial torque .....          | 35                                         |
| Final torque                  |                                            |
| All bolts except bolt A ..... | 35                                         |
| Bolt A .....                  | 41                                         |



**Torque specifications (continued)**

Ft-lbs (unless otherwise indicated)

|                                              |                                           |
|----------------------------------------------|-------------------------------------------|
| Exhaust manifold bolts                       |                                           |
| Center bolts                                 | 26                                        |
| All others                                   | 20                                        |
| Cylinder head bolts*                         |                                           |
| Step 1                                       | 25                                        |
| Step 2                                       | 45                                        |
| Step 3                                       | 65                                        |
| Timing chain cover bolts                     | 120 in-lbs                                |
| Camshaft sprocket bolts                      | 18                                        |
| Balancer shaft (1992 and later VIN W engine) |                                           |
| Retainer bolts                               | 120 in-lbs                                |
| Driven gear bolt                             | 15 plus an additional 35-degrees rotation |
| Drive gear retaining stud                    | 144 in-lbs                                |
| Rocker arm nut (1992 and later VIN W engine) | 20                                        |
| Vibration damper bolt                        | 70                                        |
| Lifter restrictor retainer bolts             | 145 in-lbs                                |
| Oil pan                                      |                                           |
| Bolts/studs                                  | 100 in-lbs                                |
| Nuts                                         | 200 in-lbs                                |
| Oil pump bolt                                | 65                                        |
| Rear main bearing cap bolts                  | 80                                        |
| Rear main oil seal housing bolts             | 135 in-lbs                                |
| Flywheel bolts                               | 65                                        |
| Driveplate bolts                             | 55                                        |

\*Use Permatex number 2 on the bolt threads

**1 General information**

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the 4.3L V6 engine. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part F of this Chapter.

The VIN W V6 engine introduced in 1992 is very similar to the other V6 engines in this Chapter, except it is equipped with a balancer shaft and has the Central Port Injection (CPI) fuel injection system. You can identify this engine by its unique intake plenum assembly. If there's any doubt as to whether or not you have this engine, refer to the Vehicle Identification Number (VIN) that is located on the forward edge of the dashboard on the driver's side. The VIN is visible from outside the vehicle, through the windshield. If the eighth position in the alpha-numeric code is a W, you have the VIN W engine.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part F of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

**2 Repair operations possible with the engine in the vehicle**

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of pressure washer before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Remove the hood, if necessary, to improve access to the engine as repairs are performed (see Chapter 11 if necessary).

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, timing cover gasket, oil pan gasket, crankshaft oil seals and cylinder head gaskets are all accessible with the engine in place.

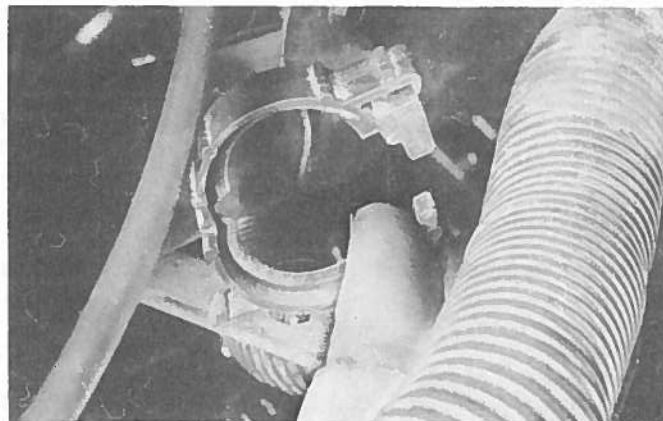
Exterior engine components, such as the intake and exhaust manifolds, the oil pan (and the oil pump), the water pump, the starter motor, the alternator, the distributor and the fuel system components can be removed for repair with the engine in place.

Since the cylinder heads can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the timing chain and sprockets is also possible with the engine in the vehicle.

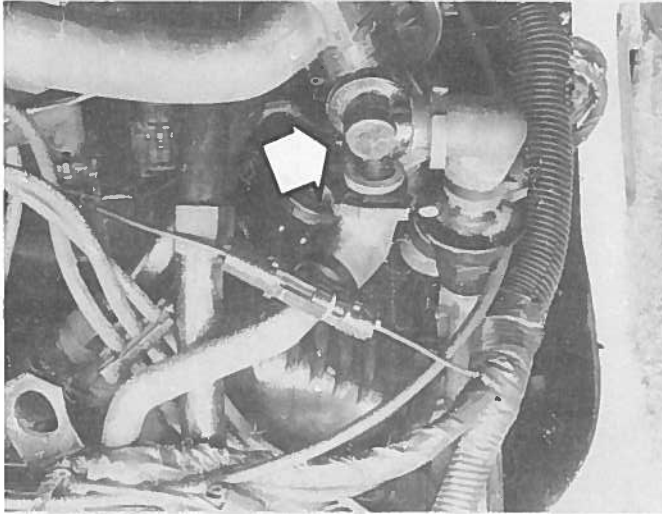
In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

**3 Valve covers - removal and installation****Removal**

- 1 Disconnect the negative cable from the battery.
- 2 Remove the air cleaner assembly (see Chapter 4).
- 3 Remove the heat stove tube, if so equipped (see Chapter 4).



**3.4 Unclip the wiring harness to make room for valve cover removal**



3.6 The diverter valve (arrow) is mounted near the rear of the right valve cover

### Right side

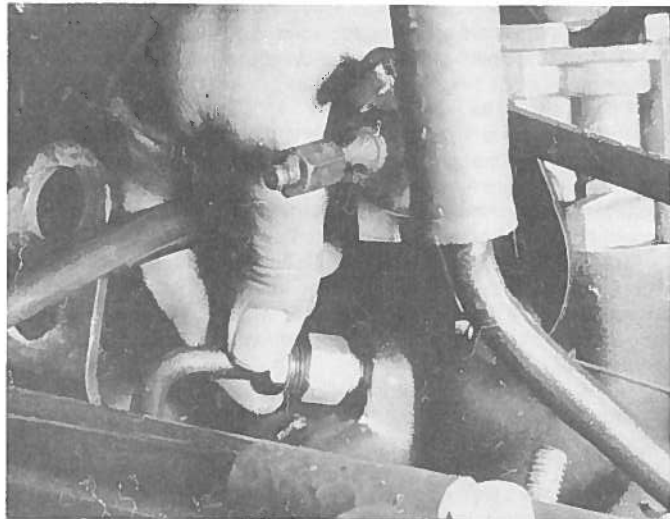
Refer to illustrations 3.4, 3.6 and 3.10

- 4 Detach the wiring harness from the clip (see illustration), then separate the tube from the valve cover.
- 5 Disconnect the crankcase ventilation pipe from the valve cover.
- 6 Working in the passenger compartment, remove the diverter valve, bracket and hoses (see illustration). Refer to Chapter 6 if necessary.
- 7 Remove the spark plug wire bracket from the right cylinder head.
- 8 Remove the ignition coil (see Chapter 5).
- 9 Finish unclipping the wire harness at the valve cover and move it aside.
- 10 Use a T-30 TORX bit to remove the valve cover bolts, then detach the cover from the head (see illustration). **Note:** If the cover is stuck to the head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).

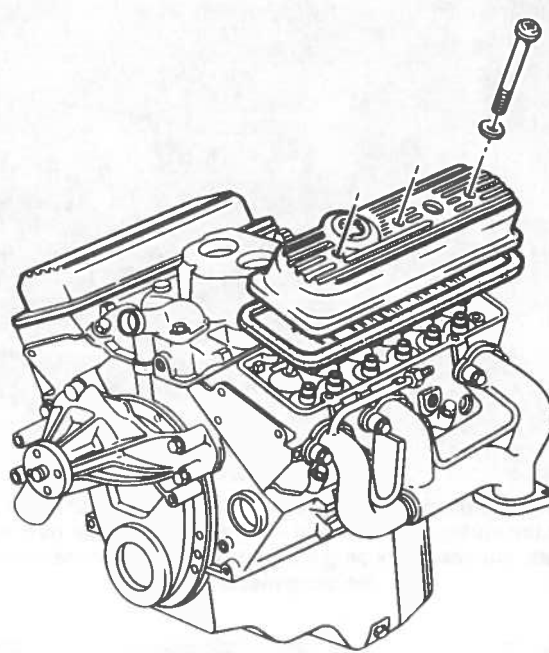
### Left side

Refer to illustrations 3.13 and 3.14

- 11 Unbolt the cruise control servo and bracket (if equipped) and set it aside (see illustration 5.8, if necessary).

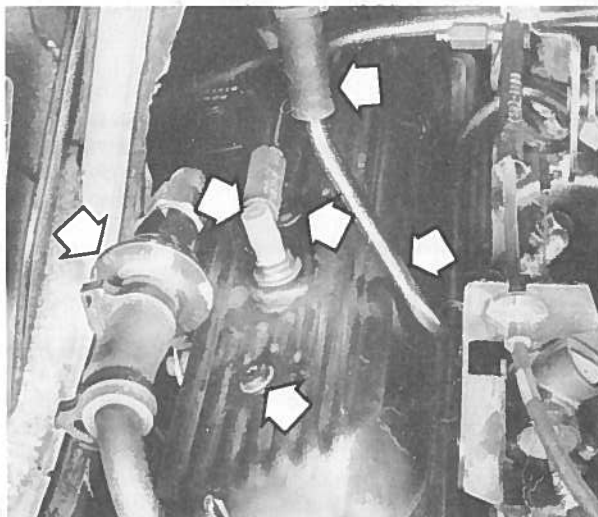


3.13 Unscrewing the power brake booster vacuum line fitting

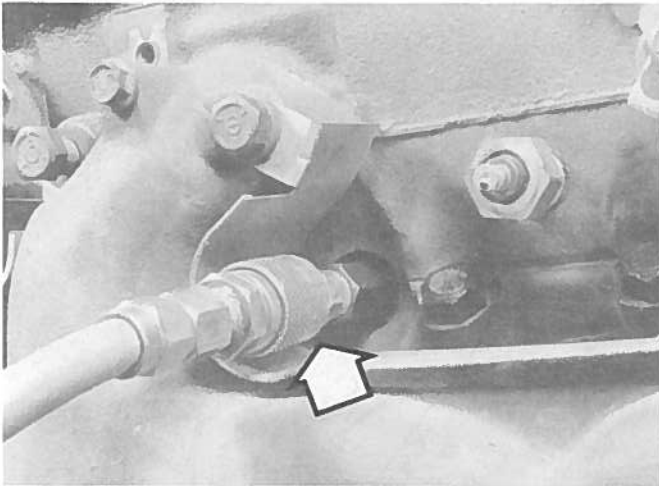


3.10 The valve cover bolts require a special tool for removal

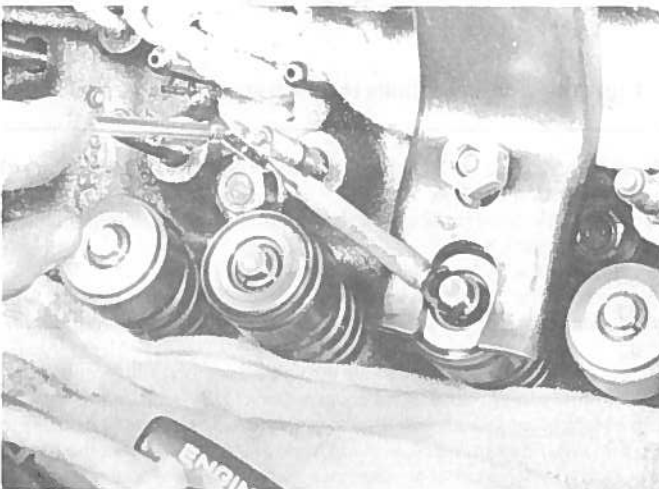
- 12 Remove the air conditioning compressor rear brace (if so equipped) (see illustration 5.6, if necessary).
- 13 Detach the power brake booster vacuum line from the intake manifold (see illustration).
- 14 Remove the PCV valve (see illustration).
- 15 Remove the spark plug wire bracket from the cylinder head.
- 16 Detach the accelerator/TV (kickdown) cable bracket from the manifold.
- 17 Use a T-30 TORX bit to remove the valve cover bolts, then detach the cover from the head. **Note:** If the cover is stuck to the head, bump one end with a block of wood and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the head and cover to break the gasket seal. Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur (leading to oil leaks in the future).



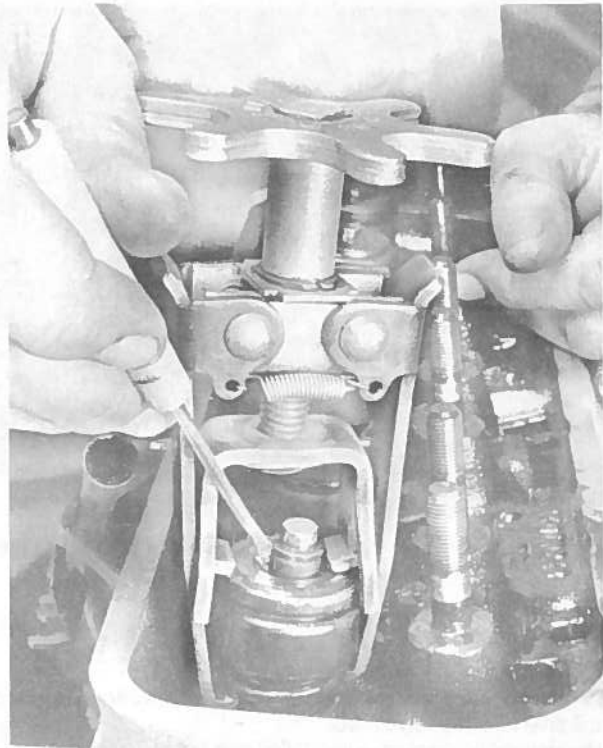
3.14 Rear view of left valve cover showing the vacuum brake booster line, the PCV valve, the AIR check valve and tube and the valve cover mounting bolts (arrows)



**4.4** Use compressed air, if available, to hold the valves closed when the springs are removed – the air hose adapter (arrow) threads into the spark plug hole and accepts the hose from the compressor



**4.8b** The stamped steel lever-type valve spring compressor is usually less expensive than the type that grips the spring coils



**4.8a** Once the spring is depressed, the keepers can be removed with a small magnet or needle-nose pliers (a magnet is preferred to prevent dropping the keepers)

### Installation

18 The mating surfaces of each cylinder head and valve cover must be perfectly clean when the covers are installed. Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's sealant or oil on the mating surfaces when the cover is installed, oil leaks may develop.

19 Clean the mounting bolt threads with a die to remove any corrosion and restore damaged threads. Make sure the threaded holes in the head are clean – run a tap into them to remove corrosion and restore damaged threads.

20 The gaskets should be mated to the covers before the covers are installed. Apply a thin coat of RTV sealant to the cover flange, then position the gasket inside the cover lip and allow the sealant to set up so the gasket adheres to the cover. If the sealant isn't allowed to set, the gasket may fall out of the cover as it's installed on the engine.

21 Carefully position the cover on the head and install the bolts.

22 Tighten the bolts in three or four steps to the torque listed in this Chapter's Specifications.

23 The remaining installation steps are the reverse of removal.

24 Start the engine and check carefully for oil leaks as the engine warms up.

### 4 Valve spring, retainer and seals – replacement

Refer to illustrations 4.4, 4.8a, 4.8b, 4.9, 4.16 and 4.17

**Note:** Broken valve springs and defective valve stem seals can be replaced without removing the cylinder heads. Two special tools and a compressed air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job. If compressed air isn't available, a length of nylon rope can be used to keep the valves from falling into the cylinder during this procedure.

1 Remove the valve cover from the cylinder head (see Section 3). If all of the valve stem seals are being replaced, remove both valve covers.

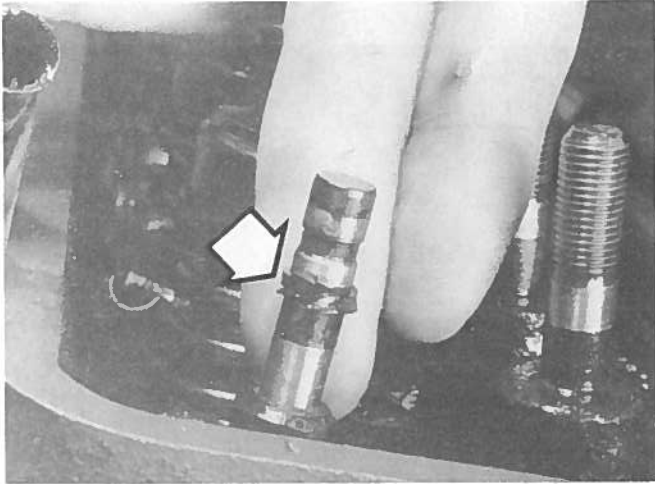
2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.

3 Turn the crankshaft until the piston in the affected cylinder is at top dead center on the compression stroke (see Section 9). If you are replacing all of the valve stem seals, begin with cylinder number one and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing order sequence (1-6-5-4-3-2).

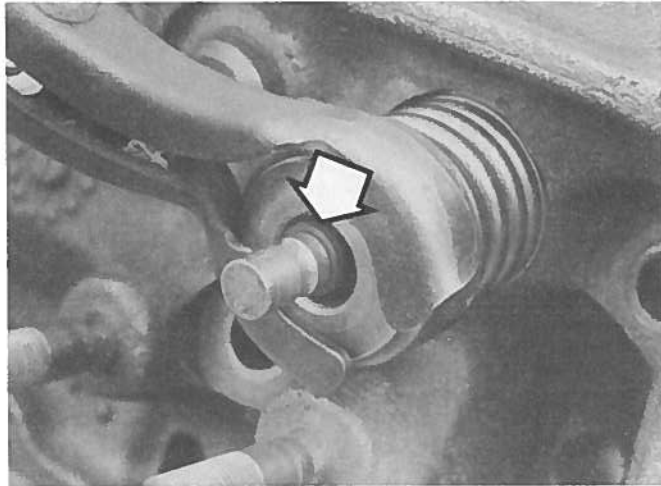
4 Thread an adapter into the spark plug hole (see illustration) and connect an air hose from a compressed air source to it. Most auto parts stores can supply the air hose adapter. **Note:** Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.

5 Remove the nut, pivot ball and rocker arm for the valve with the defective part and pull out the pushrod. If all the valve stem seals are being replaced, all of the rocker arms and pushrods should be removed (see Section 7).

6 Apply compressed air to the cylinder. The valves should be held in place by the air pressure. If the valve faces or seats are in poor condition, leaks may prevent air pressure from retaining the valves – refer to the alternative procedure below.



4.9 The O-ring seal (arrow) should be replaced with a new one each time the keepers and retainer are removed



4.16 Make sure the O-ring seal under the retainer is seated in the groove and not twisted before installing the keepers

7 If you don't have access to compressed air, an alternative method can be used. Position the piston at a point approximately 45-degrees (1/8-turn) before TDC on the compression stroke, then feed a long piece of nylon rope through the spark plug hole until it fills the combustion chamber. Be sure to leave the end of the rope hanging out of the engine so it can be removed easily. Use a large breaker bar and socket to rotate the crankshaft in the normal direction of rotation until slight resistance is felt.

8 Stuff shop rags into the cylinder head holes above and below the valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring/damper assembly. Remove the keepers with small needle-nose pliers or a magnet (*see illustration*). **Note:** A couple of different types of tools are available for compressing the valve springs with the head in place. One type, shown here, grips the lower spring coils and presses on the retainer as the knob is turned, while the other type utilizes the rocker arm stud and nut for leverage (*see illustration*). Both types work very well, although the lever type is usually less expensive.

9 Remove the spring retainer or rotator, oil shield and valve spring assembly, then remove the valve stem O-ring seal and the umbrella-type guide seal (the O-ring seal will most likely be hardened and will probably break when removed, so plan on installing a new one each time the original is removed) (*see illustration*). **Note:** If air pressure fails to hold the valve in the closed position during this operation, the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.

10 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure. **Note:** If a rope was used instead of air pressure, turn the crankshaft slightly in the direction opposite normal rotation.

11 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate that the valve is bent.

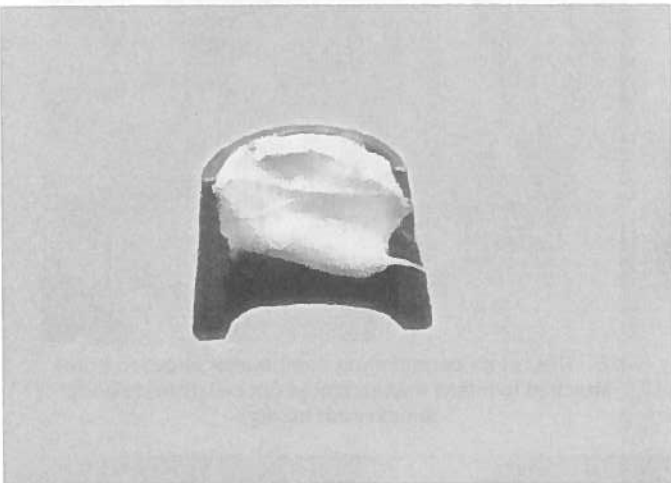
12 Move the valve up-and-down in the guide and make sure it doesn't bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the head will have to be removed for repair.

13 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem. If a rope was used instead of air pressure, rotate the crankshaft in the normal direction of rotation until slight resistance is felt.

14 Lubricate the valve stem with engine oil and install a new umbrella-type guide seal.

15 Install the spring/damper assembly and shield in position over the valve.

16 Install the valve spring retainer or rotator. Compress the valve spring assembly and carefully install the new O-ring seal in the lower groove of the valve stem. Make sure the seal isn't twisted – it must lie perfectly flat in the groove (*see illustration*).



4.17 Apply a small dab of grease to each keeper as shown here before installation – it will hold them in place on the valve stem as the spring is released

17 Position the keepers in the upper groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary (*see illustration*). Remove the pressure from the spring tool and make sure the keepers are seated.

18 Disconnect the air hose and remove the adapter from the spark plug hole. If a rope was used in place of air pressure, rotate the crankshaft counterclockwise and pull it out of the cylinder.

19 Install the rocker arm(s) and pushrod(s) (see Section 7).

20 Install the valve cover(s) (see Section 3).

21 Install the spark plug(s) and hook up the wire(s).

22 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

## 5 Intake manifold – removal and installation

### Removal

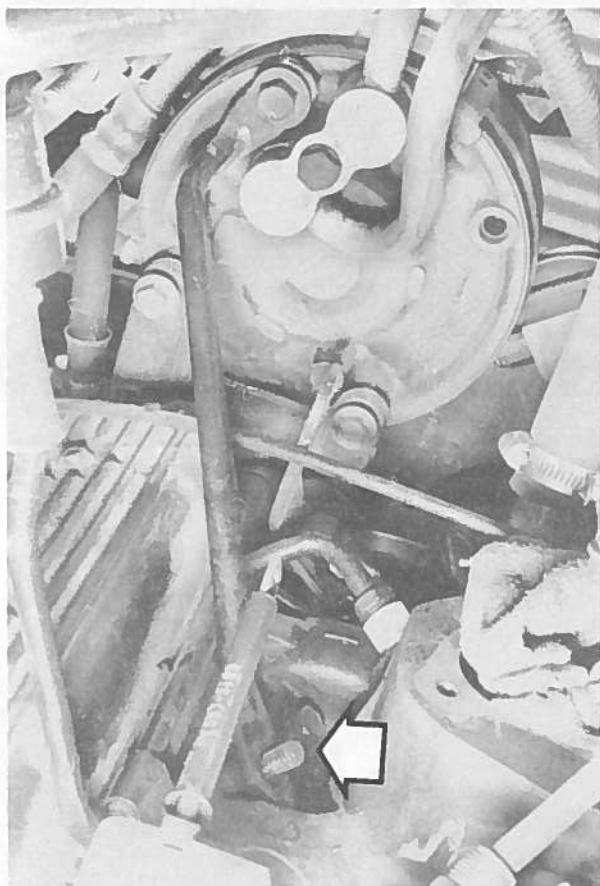
Refer to illustrations 5.6, 5.8, 5.9, 5.10 and 5.15

1 Disconnect the negative cable from the battery.

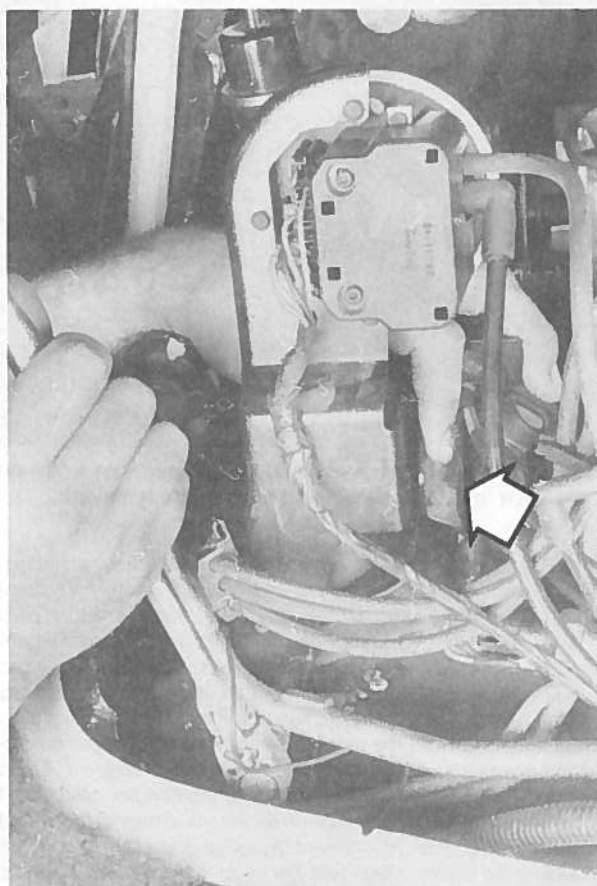
2 Remove the upper fan shroud.

3 Remove the air cleaner assembly (TBI models) or air intake tube (CPI models) (see Chapter 4).

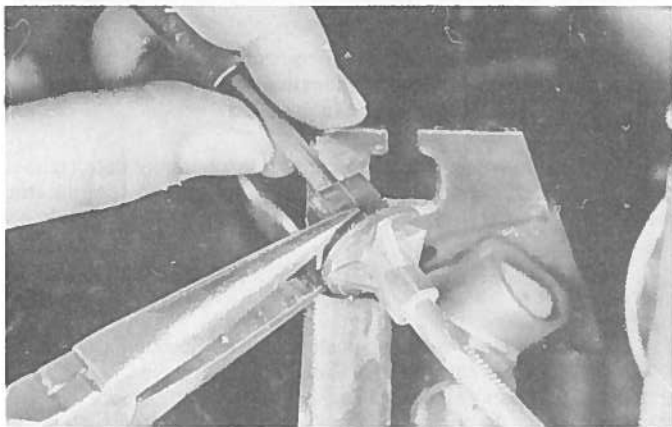




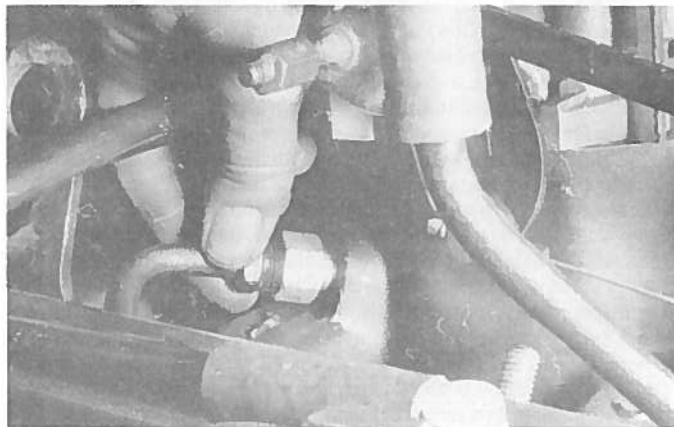
**5.6** Rear of air conditioning compressor showing brace attached to intake manifold stud (arrow) (throttle body removed for clarity)



**5.8** Arrow points to optional cruise control servo bracket bolt location – socket wrench is on lower bracket mounting bolt



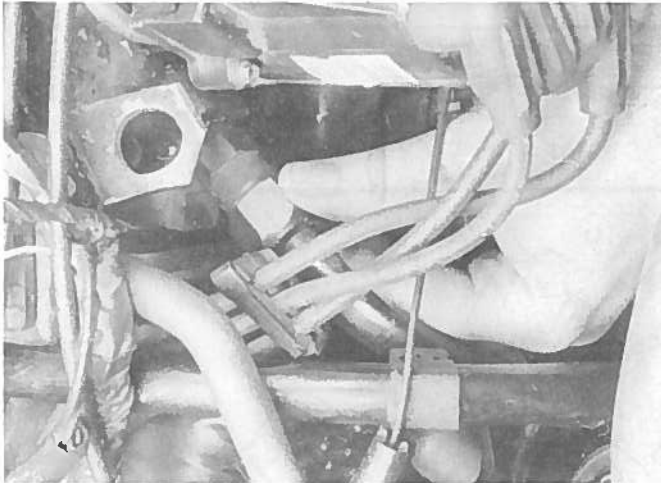
**5.9** Pinch the cable tabs together to get them out of the bracket (cable removed for clarity)



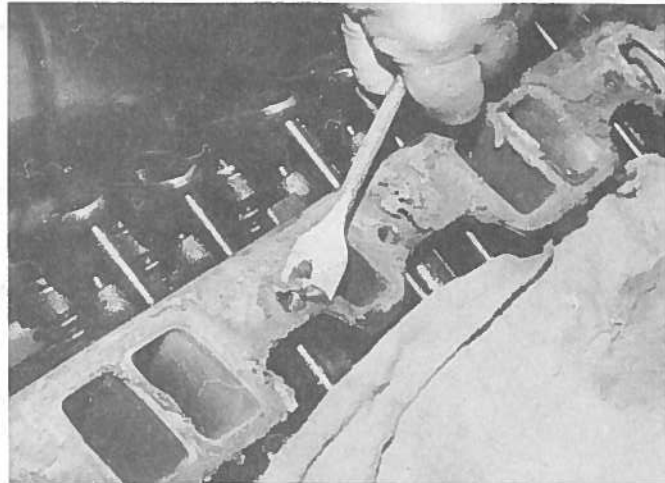
**5.10** The vacuum brake booster line-to-intake manifold fitting is to the left of the throttle body

- 4 Drain the radiator (see Chapter 1).
- 5 Disconnect the upper radiator and heater hoses at the front of the engine.
- 6 Remove the rear brace from the air conditioning compressor (see illustration).
- 7 Remove the spark plug wires, coil and distributor (see Chapters 1 and 5).
- 8 Remove the cruise control servo and brackets, if so equipped (see illustration).

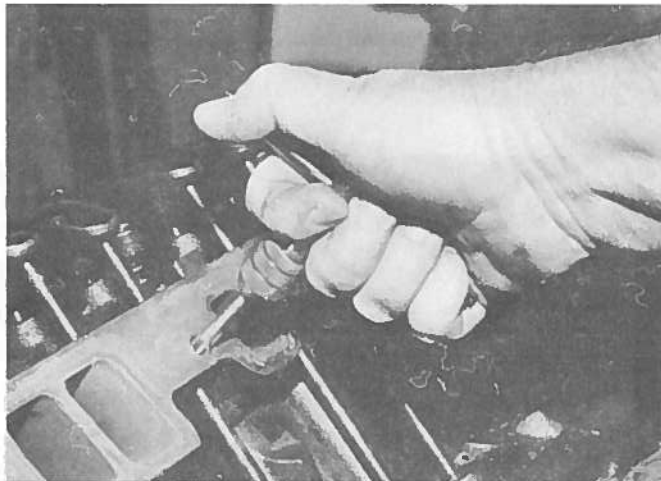
- 9 Remove the throttle, cruise control and TV cables from the bracket(s) on the manifold (see illustration).
- 10 Detach the vacuum brake booster line from the manifold (see illustration).
- 11 On models equipped with CPI fuel injection, remove the air intake plenum (see Chapter 4).
- 12 Unbolt the alternator bracket at the manifold and push it aside.
- 13 Label and disconnect the fuel lines, vacuum hoses/pipes and wires at the manifold and TBI unit or CPI unit (see Chapter 4).



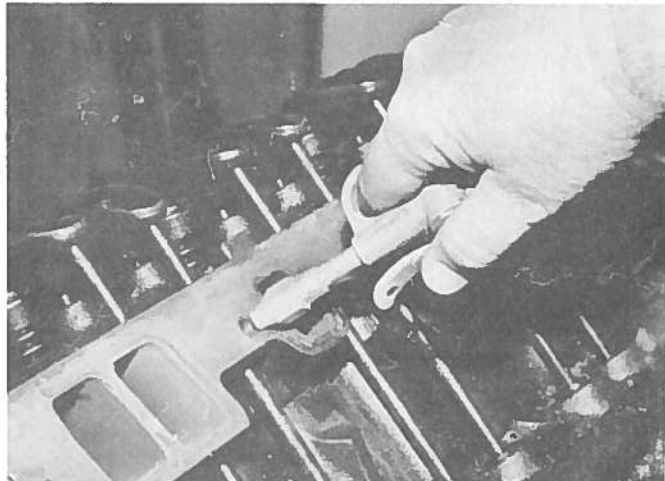
5.15 Disconnect the coolant tube at the manifold and set it aside



5.18 After covering the lifter valley, use a gasket scraper to remove all traces of sealant and old gasket material from the head and manifold mating surfaces



5.19a The bolt hole threads must be clean and dry to ensure accurate torque readings when the manifold mounting bolts are installed



5.19b Clean the bolt holes with compressed air, but be careful – wear safety goggles!

14 On TBI models, unbolt the fuel line from the rear of the cylinder head. It may be necessary to keep the stud from turning with vise-grip pliers.  
15 Remove the coolant tube from the right side of the manifold (see illustration).

16 Loosen the manifold mounting bolts in 1/4-turn increments until they can be removed by hand.

17 The manifold will probably be stuck to the cylinder heads and force may be required to break the gasket seal. A large pry bar can be positioned under the cast-in lug near the left front mounting bolt to pry up the front of the manifold, but make sure all bolts have been removed first! **Caution:** Don't pry between the block and manifold or the heads and manifold or damage to the gasket sealing surfaces may occur, leading to vacuum leaks.

### Installation

Refer to illustrations 5.18, 5.19a, 5.19b, 5.20, 5.21, 5.22, 5.23, 5.25a and 5.25b

**Note:** The mating surfaces of the cylinder heads, block and manifold must be perfectly clean when the manifold is installed. Gasket removal solvents in aerosol cans are available at most auto parts stores and may be helpful when removing old gasket material that's stuck to the heads and manifold (since the manifold is made of aluminum, aggressive scraping can cause

damage). Be sure to follow the directions printed on the container.

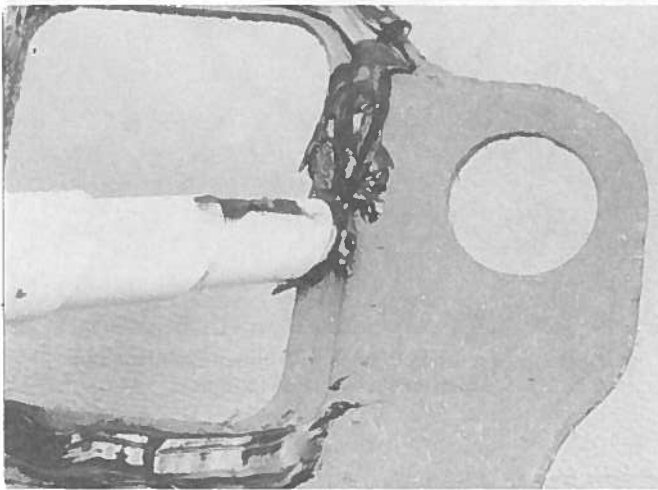
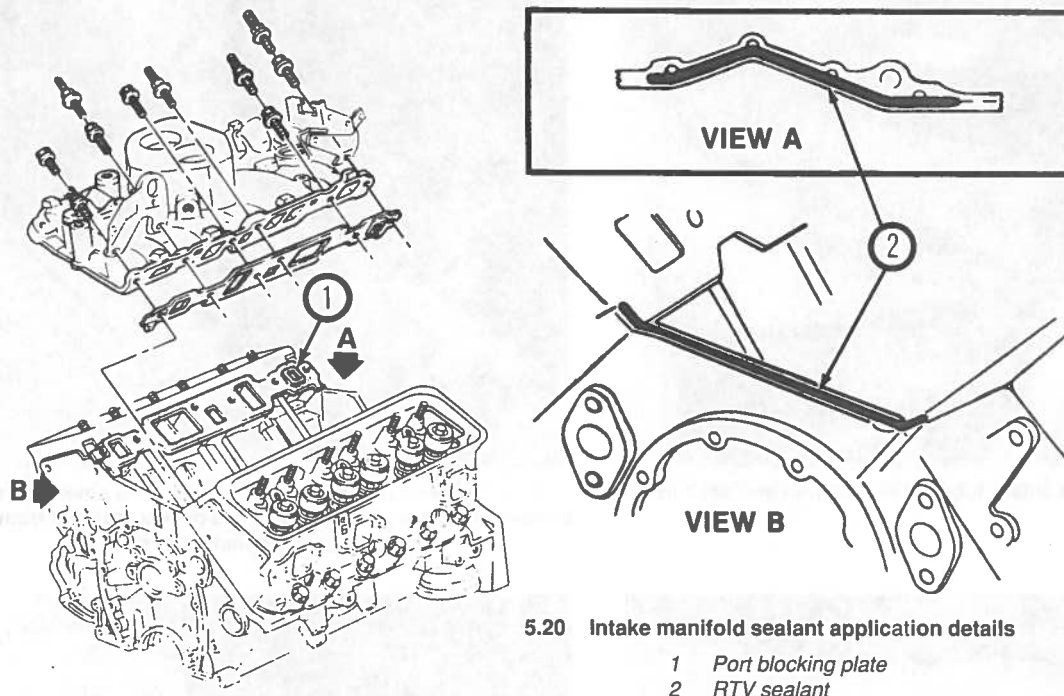
18 Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's old sealant or oil on the mating surfaces when the manifold is installed, oil or vacuum leaks may develop. When working on the heads and block, cover the lifter valley with shop rags to keep debris out of the engine (see illustration). Use a vacuum cleaner to remove any gasket material that falls into the intake ports in the heads.

19 Use a tap of the correct size to chase the threads in the bolt holes, then use compressed air (if available) to remove the debris from the holes (see illustrations). **Warning:** Wear safety glasses or a face shield to protect your eyes when using compressed air! Remove excessive carbon deposits and corrosion from the exhaust, EGR and coolant passages in the heads and manifold.

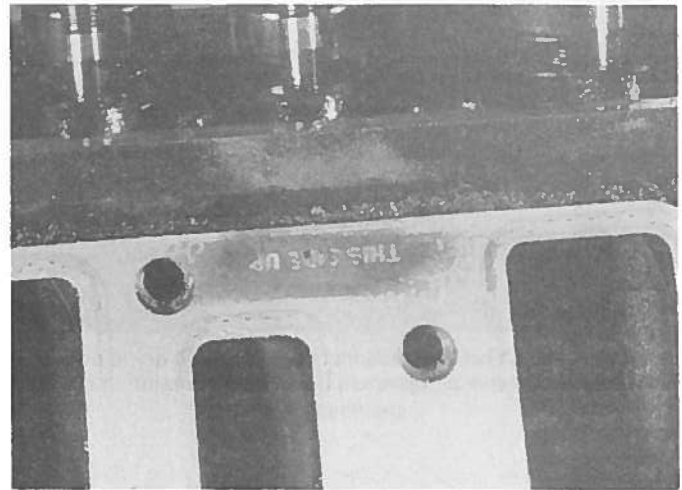
20 Apply a 3/16-inch wide bead of RTV sealant to the front and rear manifold mating surfaces of the block (see illustration). Make sure the beads extend up the heads 1/2-inch on each side.

21 Apply a thin coat of RTV sealant around the coolant passage holes on the cylinder head side of the new intake manifold gaskets (see illustration).

22 Position the gaskets on the cylinder heads, with the ears at each end overlapping the bead of RTV sealant on the head. The upper side of each



5.21 RTV sealant should be used around the coolant passage holes in the new intake manifold gaskets



5.22 Be sure to install the gaskets with the marks UP!

gasket will have a THIS SIDE UP label stamped into it to ensure correct installation (see illustration).

23 Make sure all intake port openings, coolant passage holes and bolt holes are aligned correctly. **Note:** Be sure the gaskets are installed with the blocked off coolant passages at the rear of the engine (see illustration). Some gaskets may have small tabs which must be bent over until they're flush with the rear surface of each head.

24 Carefully set the manifold in place while the sealant is still wet. **Caution:** Don't disturb the gaskets and don't move the manifold fore-and-aft after it contacts the sealant on the block.

25 Following the recommended sequence, install the bolts and tighten them to the torque listed in this Chapter's Specifications (see illustrations). Work up to the final torque in two stages and note that two different tightening sequences must be followed, one for each stage.

26 The remaining installation steps are the reverse of removal. Start the engine and check carefully for oil and coolant leaks at the intake manifold joints.

## 6 Exhaust manifolds – removal and installation

### Removal

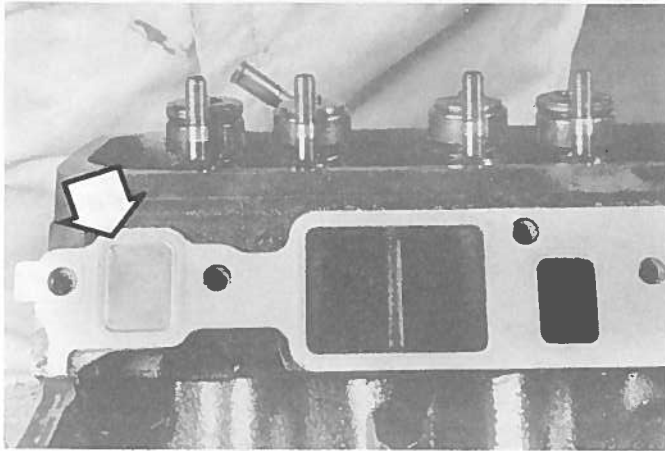
Refer to illustrations 6.7 and 6.10

- 1 Disconnect the negative battery cable from the battery.
- 2 Raise the vehicle and support it securely on jackstands.
- 3 Working under the vehicle, apply penetrating oil to the exhaust pipe-to-manifold studs and nuts (they're usually rusty).
- 4 Remove the nuts holding the exhaust pipe(s) to the manifold(s). In extreme cases you may have to heat them with a propane or acetylene torch in order to loosen them.

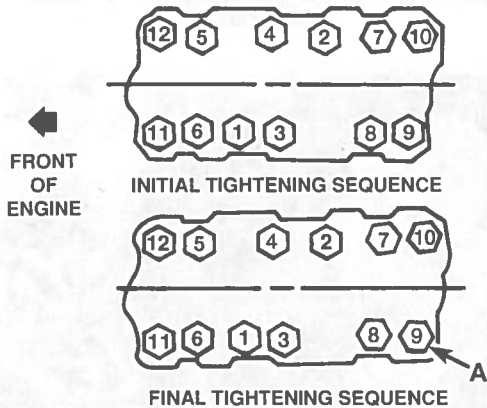
### Right side manifold

- 5 On TBI models, remove the air cleaner assembly (see Chapter 4).
- 6 Remove the heat stove pipe.
- 7 Release the hose clamp and separate the hose from the AIR system check valve (see illustration).

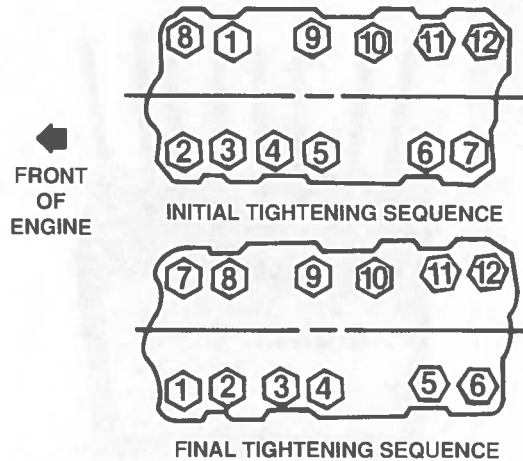




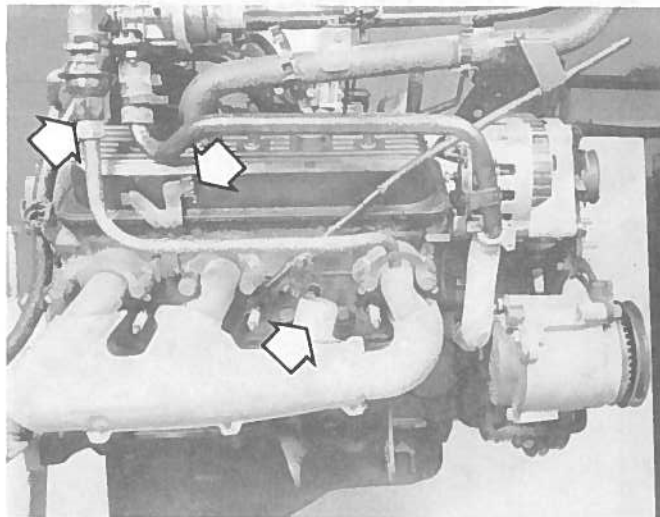
**5.23** Make sure the gaskets are installed with the blocked off holes at the rear!



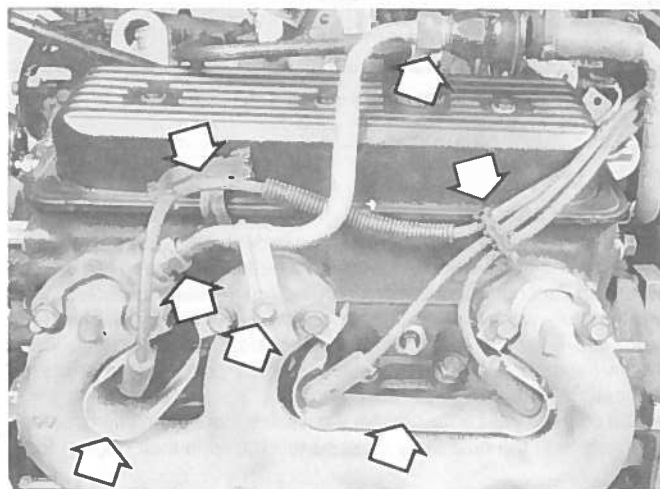
**5.25b** Intake manifold bolt tightening sequence (CPI models)  
– on the final pass, bolt A must be tightened an additional amount (see this Chapter's Specifications)



**5.25a** Intake manifold bolt tightening sequence (TBI models)



**6.7** Right side exhaust manifold mounting details showing the AIR system check valve, spark plug wire bracket and heat stove pipe mount (arrows) (engine removed for clarity)



**6.10** Left side exhaust manifold mounting details showing the spark plug wire brackets, heat shields, AIR system check valve, AIR tube-to-manifold fitting and AIR tube bracket bolt (arrows) (engine removed for clarity)

8 Detach the spark plug wires from the plugs and brackets and position them out of the way (see Chapter 1).

#### Left side manifold

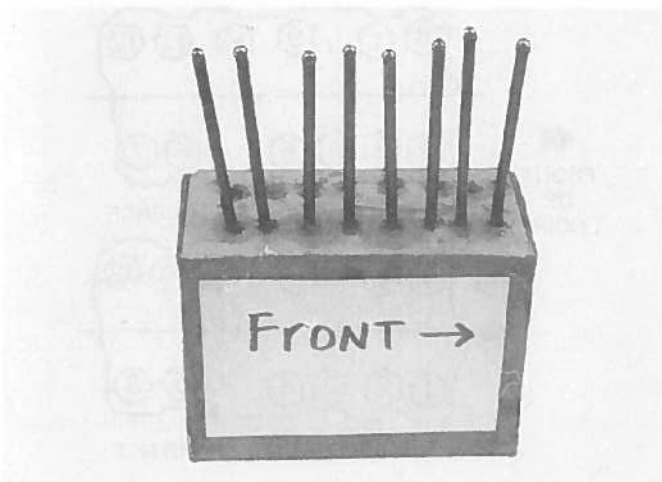
- 9 Unplug the oxygen sensor wire (see Chapter 6).
- 10 Detach the spark plug wires from the plugs and brackets and position them out of the way (see illustration).
- 11 Unscrew the fitting at the manifold, release the hose clamp and detach the hose from the AIR system check valve, then remove the bracket bolt and detach the AIR tube and check valve as an assembly.

#### Both manifolds

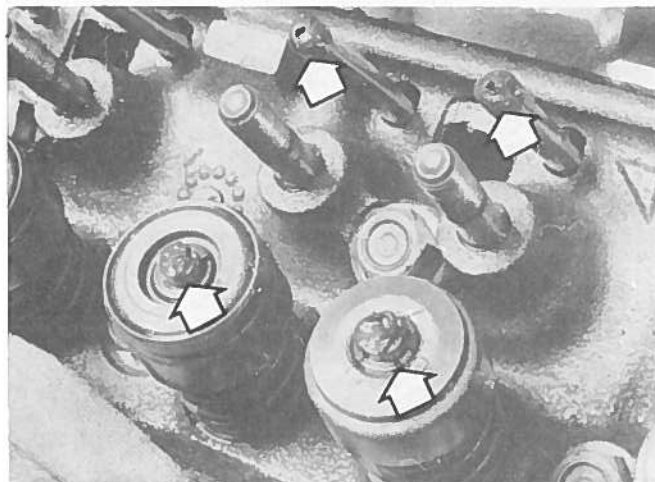
- 12 Bend the lock tabs back, then remove the mounting bolts and separate the manifold from the head. The heat shields on the left side manifold will come off after the bolts are removed.

#### Installation

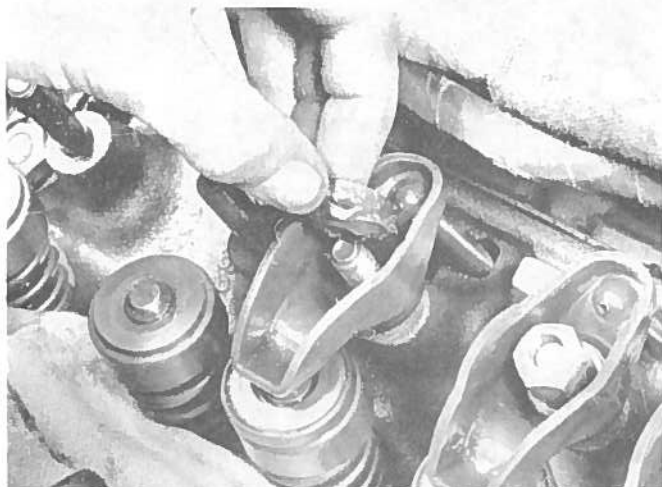
- 13 Check the manifold for cracks and make sure the bolt threads are clean and undamaged. The manifold and cylinder head mating surfaces must be clean before the manifolds are reinstalled – use a gasket scraper to remove all carbon deposits.
- 14 Position the manifold, tab washers and heat shields (if equipped) on the head and install the mounting bolts.
- 15 When tightening the mounting bolts, work from the center to the ends and be sure to use a torque wrench. Tighten the bolts in three equal steps until the torque listed in this Chapter's Specifications is reached.
- 16 The remaining installation steps are the reverse of removal.
- 17 Start the engine and check for exhaust leaks.



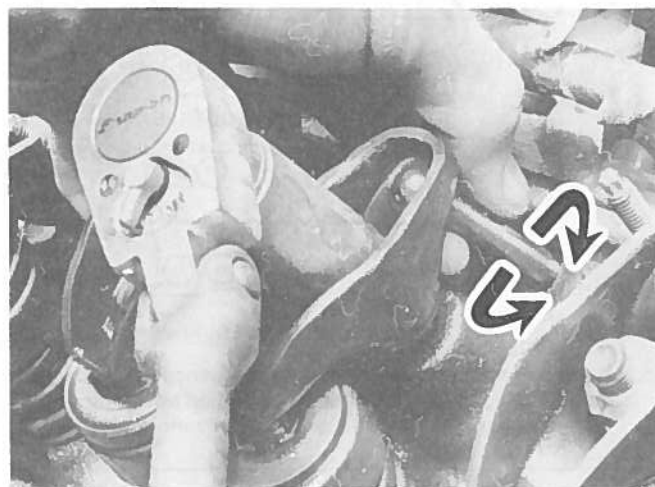
**7.4** A perforated cardboard box can be used to store the pushrods to ensure that they're reinstalled in their original locations – note the label indicating the front of the engine



**7.10** The ends of the pushrods and the valve stems should be lubricated with moly-base grease prior to installation of the rocker arms



**7.11** Moly-base grease applied to the pivot balls will ensure adequate lubrication until oil pressure builds up when the engine is started



**7.13** Rotate each pushrod as the rocker arm nut is tightened to determine the point at which all play is removed, then tighten each nut an additional one full turn

## 7 Rocker arms and pushrods – removal, inspection and installation

### Removal

Refer to illustration 7.4

- 1 Detach the valve cover(s) from the cylinder head(s) (see Section 3).
- 2 Beginning at the front of one cylinder head, loosen and remove the rocker arm stud nuts. Store them separately in marked containers to ensure that they will be reinstalled in their original locations. **Note:** If the pushrods are the only items being removed, loosen each nut just enough to allow the rocker arms to be rotated to the side so the pushrods can be lifted out.
- 3 Lift off the rocker arms and pivot balls and store them in the marked containers with the nuts (they must be reinstalled in their original locations).
- 4 Remove the pushrods and store them separately to make sure they don't get mixed up during installation (see illustration).

### Inspection

- 5 Check each rocker arm for wear, cracks and other damage, especial-

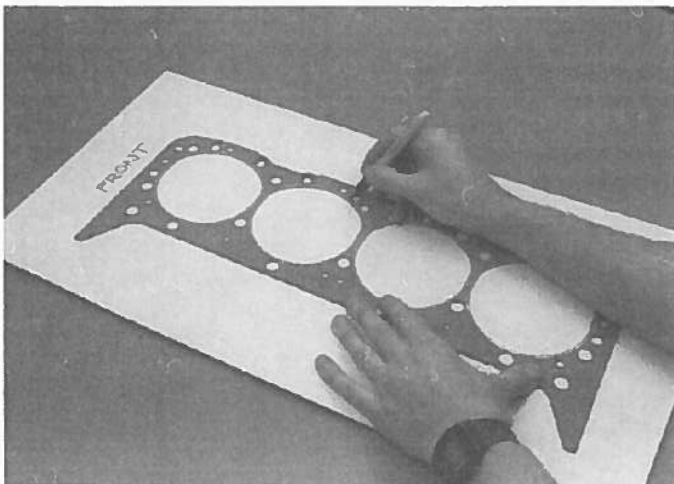
ly where the pushrods and valve stems contact the rocker arm faces.

- 6 Make sure the hole at the pushrod end of each rocker arm is open.
- 7 Check each rocker arm pivot area for wear, cracks and galling. If the rocker arms are worn or damaged, replace them with new ones and use new pivot balls as well.
- 8 Inspect the pushrods for cracks and excessive wear at the ends. Roll each pushrod across a piece of plate glass to see if it's bent (if it wobbles, it's bent).

### Installation

Refer to illustrations 7.10 and 7.11

- 9 Lubricate the lower end of each pushrod with clean engine oil or moly-base grease and install them in their original locations. Make sure each pushrod seats completely in the lifter.
- 10 Apply moly-base grease to the ends of the valve stems and the upper ends of the pushrods before positioning the rocker arms over the studs (see illustration).
- 11 Set the rocker arms in place, then install the pivot balls and nuts. Apply moly-base grease to the pivot balls to prevent damage to the mating surfaces before engine oil pressure builds up (see illustration). Be sure to install each nut with the flat side against the pivot ball.



**8.13** To avoid mixing up the head bolts, use a new gasket to transfer the bolt hole pattern to a piece of cardboard, then punch holes to accept the bolts

### Valve adjustment (all except 1992 and later VIN W engines)

**Note:** On 1992 and later VIN W engines, there are no provisions for valve adjustment. The rocker arm studs have a positive stop shoulder for the rocker arm. After valve service, tighten the rocker arm nuts to the torque listed in this Chapter's Specifications. Unless there have been machining operations that significantly altered the valve lash, the adjustment should be correct.

Refer to illustration 7.13

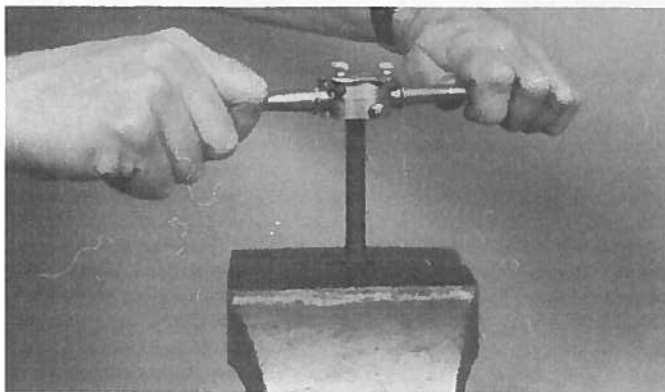
- 12 Bring the number one piston to top dead center on the compression stroke (see Section 9).
- 13 Tighten the rocker arm nuts (number one cylinder only) until all play is removed at the pushrods. This can be determined by rotating each pushrod between your thumb and index finger as the nut is tightened (see illustration). You'll be able to feel the point at which all play is eliminated because the pushrod will no longer turn.
- 14 Tighten each nut an additional one full turn (360-degrees) to center the lifters. Valve adjustment for cylinder number one is now complete.
- 15 Turn the crankshaft 120-degrees in the normal direction of rotation until the next piston in the firing order (number six) is at TDC on the compression stroke. The distributor rotor should be pointing in the direction of terminal number six on the cap (see Section 9 for additional information).
- 16 Repeat the procedure described in Steps 13 and 14 for the number six cylinder valves.
- 17 Turn the crankshaft another 120-degrees and adjust the number five cylinder valves. Continue turning the crankshaft 120-degrees at a time and adjust both valves for each cylinder before proceeding. Follow the firing order sequence (a cylinder number illustration is also included) in the Specifications.
- 18 Install the valve covers (see Section 3). Start the engine, listen for unusual valvetrain noises and check for oil leaks at the valve cover joints.

## 8 Cylinder heads – removal and installation

**Note:** The engine must be completely cool when the heads are removed. Failure to allow the engine to cool off could result in head warpage.

### Removal

- 1 Remove the intake manifold (see Section 5).
- 2 Remove the valve cover (see Section 3).
- 3 Remove the pushrods (see Section 7).
- 4 Raise and support the vehicle on jackstands.



**8.20** A die should be used to remove sealant and corrosion from the head bolt threads prior to installation

### Left (driver's side) cylinder head

- 5 Remove the air conditioning and power steering pump drivebelts, if equipped (see Chapter 1).
- 6 Unbolt the power steering pump and lay it aside. Leave the hoses connected (see Chapter 10).
- 7 Remove the air conditioning compressor, idler pulley and bracket, if equipped (see Chapter 3).
- 8 Remove the exhaust manifold (see Section 6).
- 9 Proceed to Step 13.

### Right cylinder head

- 10 Remove the engine ground wire and electrical harness at the rear of the head.
- 11 Remove the diverter valve assembly (see Chapter 6).
- 12 Remove the alternator (see Chapter 5).

### Both cylinder heads

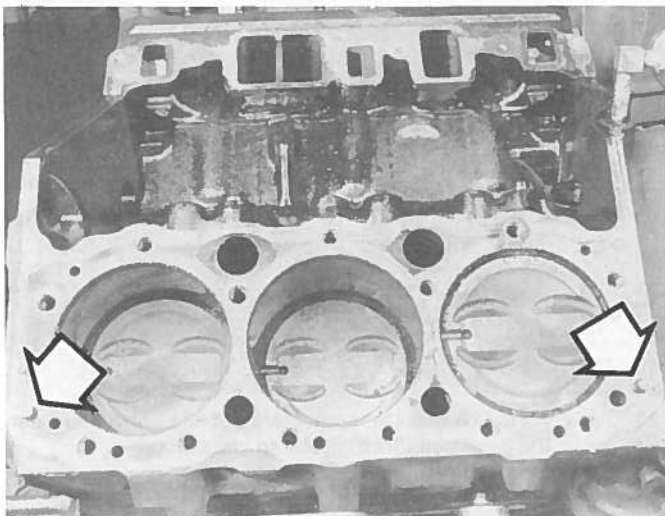
Refer to illustration 8.13

- 13 Using a new head gasket, outline the cylinders and bolt pattern on a piece of cardboard (see illustration). Be sure to indicate the front of the engine for reference. Punch holes at the bolt locations.
- 14 Loosen the head bolts in 1/4-turn increments until they can be removed by hand. Work from bolt-to-bolt in a pattern that's the reverse of the tightening sequence shown in illustration 8.24. **Note:** Don't overlook the row of bolts on the lower edge of each head, near the spark plug holes. Store the bolts in the cardboard holder as they're removed; this will ensure that the bolts are reinstalled in their original holes.
- 15 Lift the head(s) off the engine. If resistance is felt, DO NOT pry between the head and block as damage to the mating surfaces will result. To dislodge the head, place a block of wood against the end of it and strike the wood block with a hammer. Store the heads on blocks of wood to prevent damage to the gasket sealing surfaces.
- 16 Cylinder head disassembly and inspection procedures are covered in detail in Chapter 2, Part F.

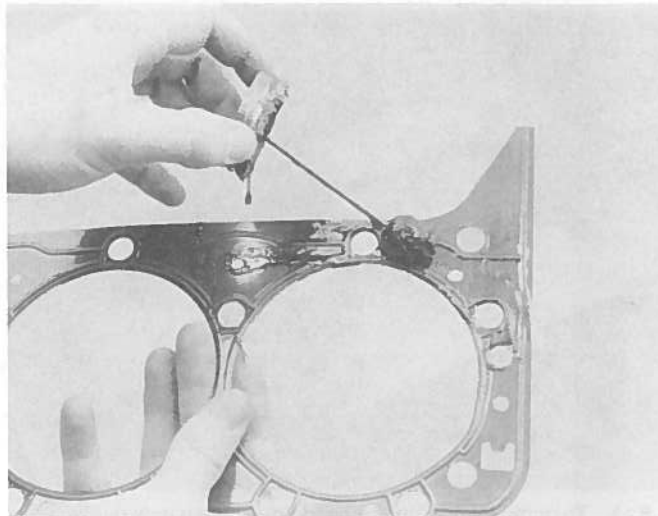
### Installation

Refer to illustrations 8.20, 8.21a, 8.21b, 8.23 and 8.24

- 17 The mating surfaces of the cylinder heads and block must be perfectly clean when the heads are installed.
- 18 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's oil on the mating surfaces when the heads are installed, the gaskets may not seal correctly and leaks may develop. When working on the block, cover the lifter valley with shop rags to keep debris out of the engine. Use a vacuum cleaner to remove any debris that falls into the cylinders.
- 19 Check the block and head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with a file – if it's excessive, machining may be the only alternative.
- 20 Use a tap of the correct size to chase the threads in the head bolt holes. Mount each bolt in a vise and run a die down the threads to remove corrosion and restore the threads (see illustration). Dirt, corrosion, sealant and damaged threads will affect torque readings.



**8.21a** Locating dowels (arrows) are used to position the head gaskets on the block



**8.21b** Steel gaskets should be coated with a sealant such as K&W Copper Coat before installation

21 Position the new gaskets over the dowel pins in the block (see illustration). **Note:** If a steel gasket is used, apply a thin, even coat of sealant such as K&W Copper Coat to both sides prior to installation (see illustration). Steel gaskets must be installed with the raised bead UP. The composition gasket must be installed dry – don't use sealant.

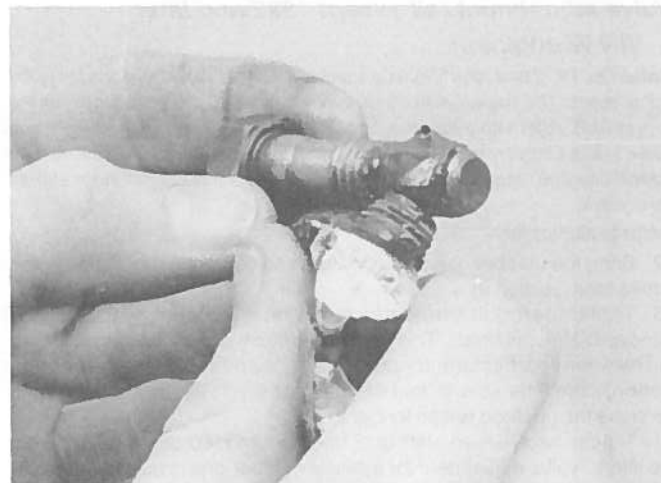
22 Carefully position the heads on the block without disturbing the gaskets.

23 Before installing the head bolts, coat the threads with a nonhardening sealant such as Permatex no. 2 (see illustration).

24 Install the bolts in their original locations and tighten them finger tight. Follow the recommended sequence and tighten the bolts in several steps to the torque listed in this Chapter's Specifications (see illustration).

25 The remaining installation steps are the reverse of removal.

26 Change the engine oil and filter (see Chapter 1), then start the engine and check carefully for oil and coolant leaks.



**8.23** The head bolts **MUST** be coated with a nonhardening sealant (such as Permatex no. 2) before they're installed – coolant will leak past the bolts if this isn't done

## 9 Top Dead Center (TDC) for number 1 piston – locating

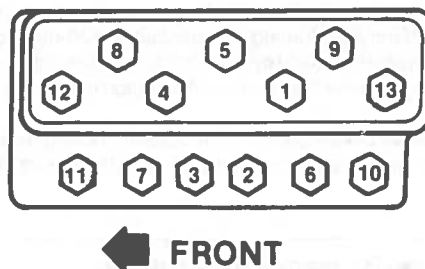
Refer to illustrations 9.4a, 9.4b, 9.6a, 9.6b and 9.7

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches as it travels up-and-down when the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke. The timing marks on the vibration damper installed on the front of the crankshaft are referenced to the number one piston at TDC on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as rocker arm removal, valve adjustment, timing chain and sprocket replacement and distributor removal.

3 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise. **Warning:** Before beginning this procedure, be sure to place the transmission in Neutral and unplug the electrical connector(s) at the distributor to disable the ignition system.

- The preferred method is to turn the crankshaft with a large socket and breaker bar attached to the vibration damper bolt threaded into the front of the crankshaft.
- A remote starter switch, which may save some time, can also be used. Attach the switch leads to the S (switch) and B (battery) terminals on the starter motor. Once the piston is close to TDC, use a socket and breaker bar as described in the previous paragraph.
- If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without

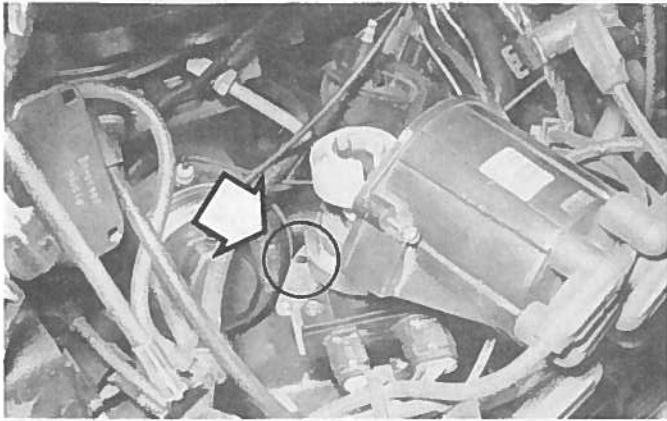


**8.24** Cylinder head bolt tightening sequence

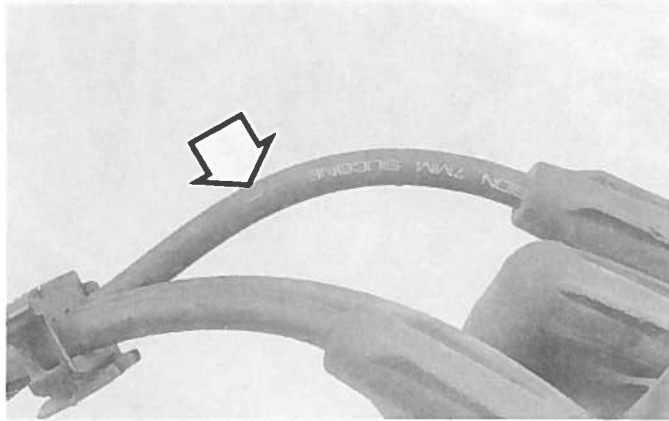
a remote starter switch. Use a socket and breaker bar as described in Paragraph a) to complete the procedure.

- Make a mark on the distributor housing directly below the number one spark plug wire terminal on the distributor cap (see illustration). **Note:** The terminal numbers are marked on the spark plug wires near the distributor (see illustration).

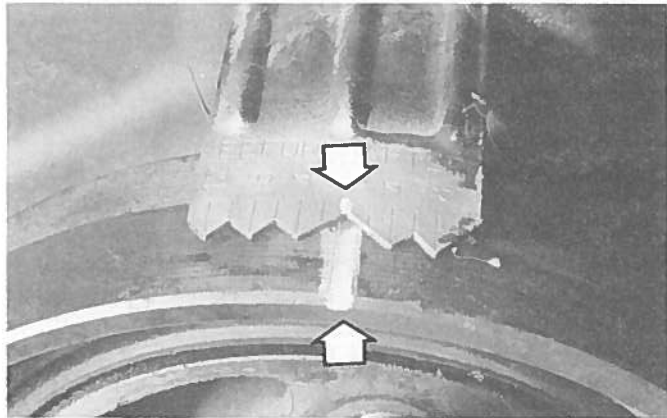




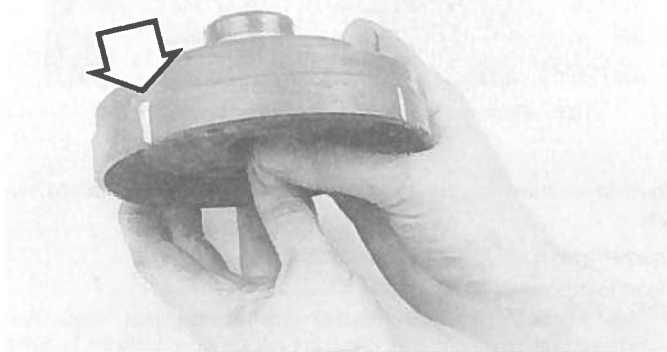
**9.4a** Make a mark on the distributor housing directly below the number 1 spark plug wire (arrow)



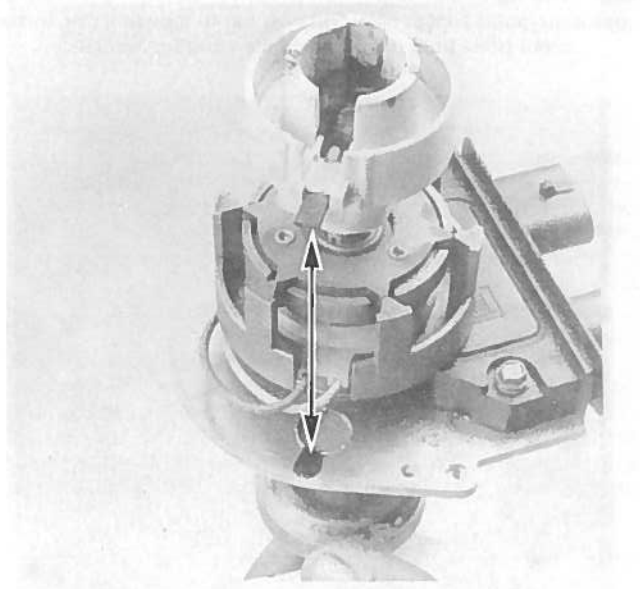
**9.4b** The spark plug wires are numbered to correspond to their respective cylinders (arrow)



**9.6a** Turn the crankshaft until the line on the vibration damper is directly opposite the zero mark on the timing plate as shown here



**9.6b** The vibration damper has two marks – the first one that approaches the timing plate can be disregarded, while the second mark (arrow) is the one that's used to locate TDC



**9.7** If the rotor is pointing directly at the mark on the distributor housing, as shown here, the number one piston is at TDC on the compression stroke

**8** To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360-degrees) clockwise. The rotor should now be pointing at the mark. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap (which is indicated by the mark on the housing) and the ignition timing marks are aligned, the number one piston is at TDC on the compression stroke.

**9** After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining cylinders can be located by turning the crankshaft 120-degrees at a time and following the firing order (see the Specifications at the beginning of this Chapter).

## 10 Timing cover, chain and sprockets – removal and installation

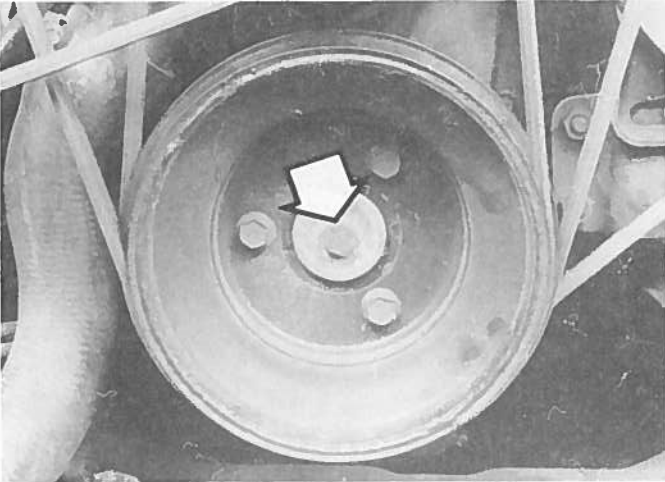
### Removal

Refer to illustrations 10.2, 10.4, 10.5 and 10.6

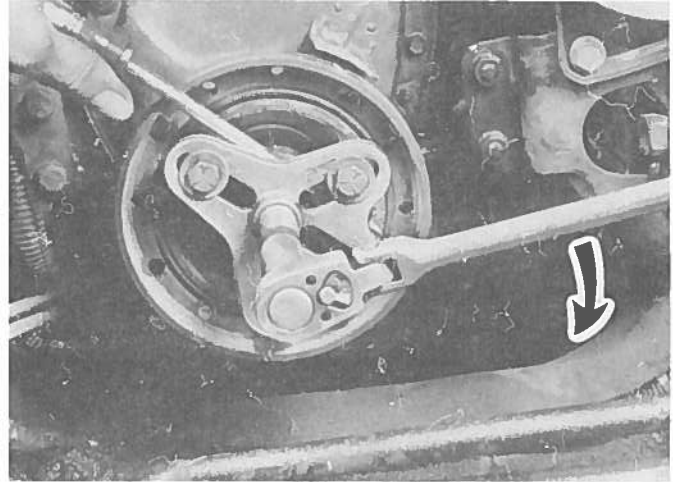
**1** Refer to Chapter 3 and remove the water pump.

**2** Remove the bolts and separate the crankshaft drivebelt pulley from the vibration damper (see illustration).

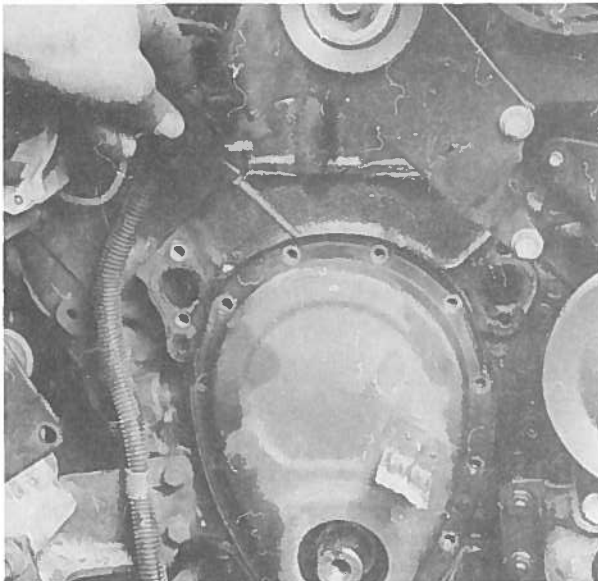




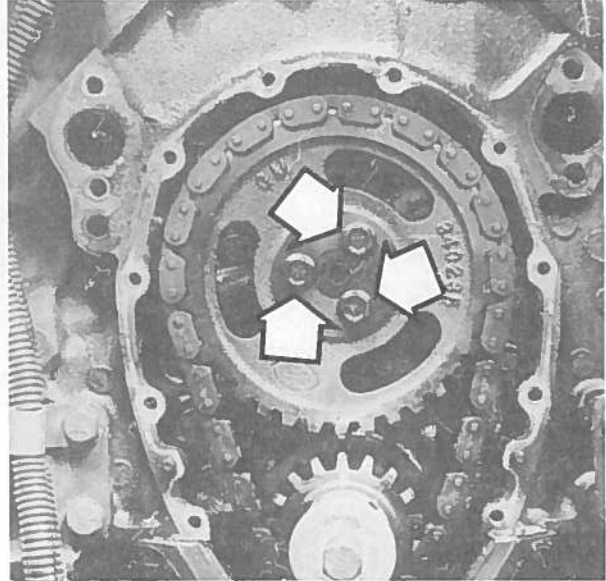
**10.2** The vibration damper bolt (arrow) is usually very tight, so use a six-point socket and a breaker bar to loosen it (the three other bolts hold the pulley to the vibration damper)



**10.4** Use the recommended puller to remove the vibration damper – if a puller that applies force to the outer edge is used, the damper will be damaged!



**10.5** A putty knife or screwdriver can be used to break the timing chain cover-to-block seal, but be careful when prying it off as damage to the cover may result



**10.6** Remove the three bolts from the end of the camshaft (arrows)

3 Position the number four piston at TDC on the compression stroke (see Section 9). **Caution:** Once this has been done, DO NOT turn the crankshaft until the timing chain and sprockets have been reinstalled!

4 Remove the bolt from the front of the crankshaft, then use a puller to detach the vibration damper (see illustration). **Caution:** Don't use a puller with jaws that grip the outer edge of the damper. The puller must be the type shown in the illustration that utilizes bolts to apply force to the damper hub only.

5 Remove the bolts and separate the timing chain cover from the block. It may be stuck – if so, use a putty knife or screwdriver to break the gasket seal (see illustration). The cover is easily distorted, so be very careful when prying it off.

6 Remove the three bolts (all except VIN W) or two bolts and one nut (VIN W) from the end of the camshaft (see illustration), then detach the camshaft sprocket and chain as an assembly. **Note:** On VIN W engines, the balancer shaft drive gear will stay attached to the camshaft and the driven gear will stay attached to the balancer shaft. The sprocket on the crankshaft can be removed with a two- or three-jaw puller, but be careful not to damage the threads in the end of the crankshaft. **Note:** If the timing

chain cover oil seal has been leaking, refer to Section 15 and install a new one.

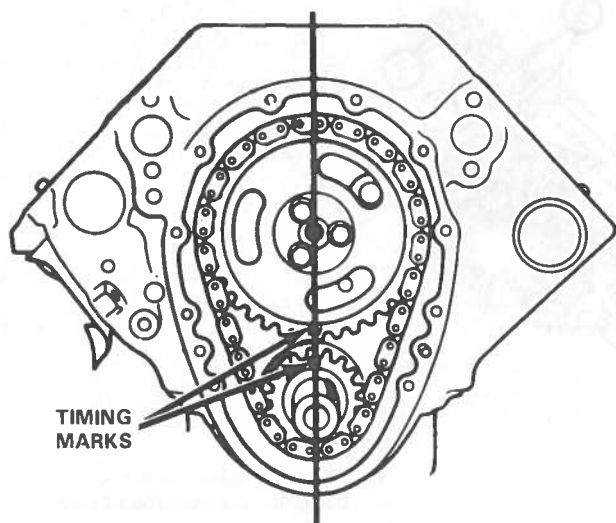
### Installation

Refer to illustration 10.10

7 Use a gasket scraper to remove all traces of old gasket material and sealant from the cover and engine block. Stuff a shop rag into the opening at the front of the oil pan to keep debris out of the engine. Clean the cover and block sealing surfaces with lacquer thinner or acetone.

8 Check the cover flange for distortion, particularly around the bolt holes. If necessary, place the cover on a block of wood and use a hammer to flatten and restore the gasket surface.

9 If new parts are being installed, be sure to align the keyway in the crankshaft sprocket with the Woodruff key in the end of the crankshaft. Press the sprocket onto the crankshaft with the vibration damper bolt, a large socket and some washers or tap it gently into place until it's completely seated. **Caution:** If resistance is encountered, DO NOT hammer the sprocket onto the crankshaft. It may eventually move onto the shaft, but it may be cracked in the process and fail later, causing extensive engine damage.



**10.10** With the number four piston at TDC on the compression stroke and the timing marks on the cam and crankshaft sprockets in the 6 and 12 o'clock positions, a straight line should pass through the camshaft timing mark, the center of the camshaft, the crankshaft timing mark and the center of the crankshaft as shown here

10 Loop the new chain over the camshaft sprocket, then turn the sprocket until the timing mark is in the 6 o'clock position. Mesh the chain with the crankshaft sprocket and position the camshaft sprocket on the end of the cam. If necessary, turn the camshaft so the dowel pin fits into the sprocket hole with the timing mark in the 6 o'clock position. When correctly installed, the marks on the sprockets will be aligned as shown (**see illustration**). **Note:** The number four piston must be at TDC on the compression stroke as the chain and sprockets are installed (**see Step 3** above).

11 Apply Loctite to the camshaft sprocket bolt threads, then install and tighten them to the torque listed in this Chapter's Specifications. Lubricate the chain with clean engine oil.

12 Check the oil pan-to-block joints to make sure that all excess sealant is removed.

13 Apply RTV sealant to the U-shaped channel on the bottom of the cover.

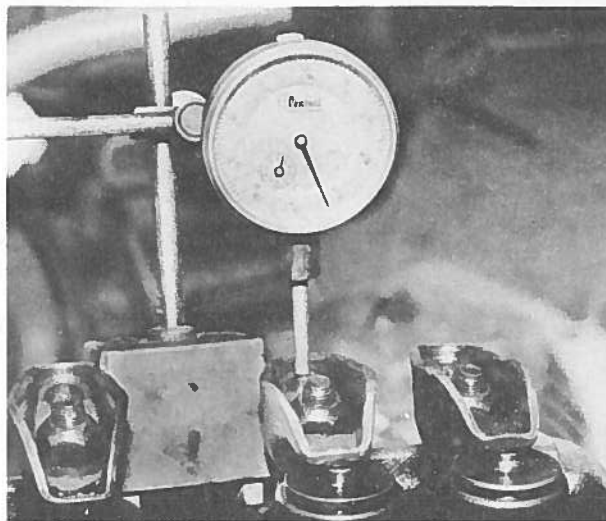
14 Apply a thin layer of RTV sealant to both sides of the new gasket, then position it on the engine block (the dowel pins and sealant will hold it in place).

15 Since the oil pan seal in the bottom of the cover must be compressed in order to position the cover over the dowel pins and thread the bolts into the block, the cover is nearly impossible to install unless the oil pan is removed first. It can be done, but it's very difficult and frustrating. If the front three bolts on each side of the oil pan are removed, the oil pan can be pried down slightly, allowing the cover to be installed. Squirt some RTV sealant into the gap between the pan and the block. If difficulty is encountered, it may be necessary to remove the oil pan.

16 Install the timing chain cover and tighten the bolts to the torque listed in this Chapter's Specifications. If the front of the oil pan was pried down, install the bolts and tighten them to the torque listed in this Chapter's Specifications.

17 Lubricate the oil seal contact surface of the vibration damper hub with moly-base grease or clean engine oil, then install the damper on the end of the crankshaft. The keyway in the damper must be aligned with the Woodruff key in the crankshaft nose. If the damper cannot be seated by hand, slip a large washer over the bolt, install the bolt and tighten it to push the damper into place. Remove the large washer and tighten the bolt to the torque listed in this Chapter's Specifications.

18 The remaining installation steps are the reverse of removal.



**11.3** When checking the camshaft lobe lift, the dial indicator plunger must be positioned directly above the pushrod

## 11 Camshaft, bearings and lifters – removal, inspection and installation

### Camshaft lobe lift check

Refer to illustration 11.3

1 In order to determine the extent of cam lobe wear, the lobe lift should be checked prior to camshaft removal. Remove the valve covers (**see Section 3**).

2 Position the number one piston at TDC on the compression stroke (**see Section 9**).

3 Beginning with the number one cylinder valves, mount a dial indicator on the engine and position the plunger against the top surface of the first rocker arm. The plunger should be directly above and in line with the pushrod (**see illustration**).

4 Zero the dial indicator, then very slowly turn the crankshaft in the normal direction of rotation until the indicator needle stops and begins to move in the opposite direction. The point at which it stops indicates maximum cam lobe lift.

5 Record this figure for future reference, then reposition the piston at TDC on the compression stroke.

6 Move the dial indicator to the remaining number one cylinder rocker arm and repeat the check. Be sure to record the results for each valve.

7 Repeat the check for the remaining valves. Since each piston must be at TDC on the compression stroke for this procedure, work from cylinder-to-cylinder following the firing order sequence.

8 After the check is complete, compare the results to this Chapter's Specifications. If camshaft lobe lift is less than specified, cam lobe wear has occurred and a new camshaft should be installed.

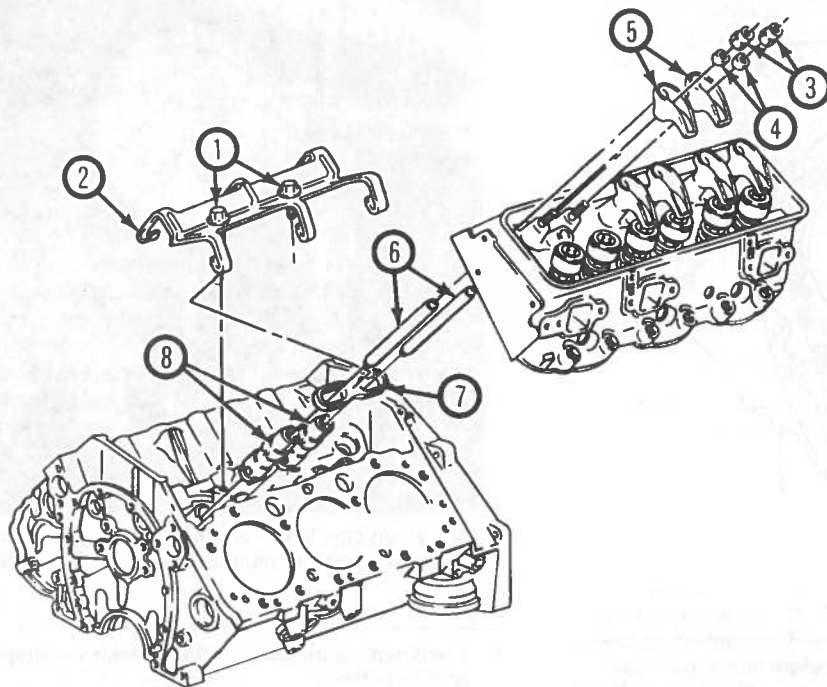
### Removal

Refer to illustrations 11.10a, 11.10b and 11.12

9 Refer to the appropriate Sections and remove the intake manifold, the rocker arms, the pushrods and the timing chain and camshaft sprocket. The radiator should be removed as well (**see Chapter 3**).

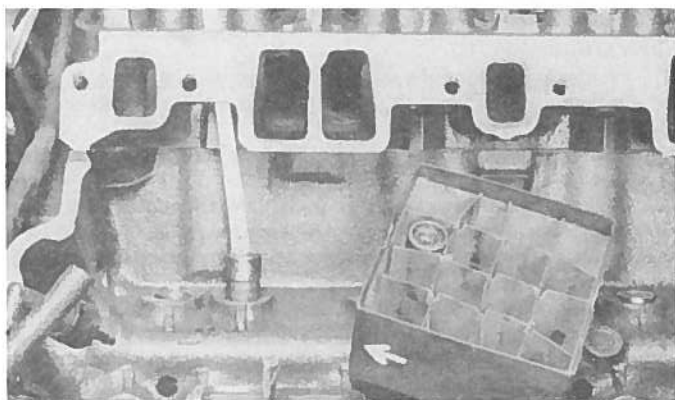
10 Before removing the lifters, arrange to store them in a clearly labelled box to ensure that they're reinstalled in their original locations. Remove the lifter retainer and restrictors (**see illustration**). Remove the lifters and store them where they won't get dirty (**see illustration**). DO NOT attempt to withdraw the camshaft with the lifters in place.

11 There are several ways to extract the lifters from the bores. A special tool designed to grip and remove lifters is manufactured by many tool companies and is widely available, but it may not be required in every case. On newer engines without a lot of varnish buildup, the lifters can often be removed with a small magnet or even with your fingers. A machinist's scribe



11.10a Hydraulic lifters and related components – exploded view

|               |                    |
|---------------|--------------------|
| 1 Bolt        | 5 Rocker arms      |
| 2 Retainer    | 6 Pushrods         |
| 3 Nuts        | 7 Restrictor       |
| 4 Pivot balls | 8 Hydraulic lifter |



11.10b The lifters on an engine that has accumulated many miles may have to be removed with a special tool – be sure to store the lifters in an organized manner to make sure they are reinstalled in their original locations

with a bent end can be used to pull the lifters out by positioning the point under the retainer ring in the top of each lifter. **Caution:** Don't use pliers to remove the lifters unless you intend to replace them with new ones (along with the camshaft). The pliers will damage the precision machined and hardened lifters, rendering them useless.

12 On VIN W engines, remove the balancer shaft drive and driven gears (see Section 12).

13 Thread two 6-inch long 5/16-18 bolts into two of the camshaft sprocket bolt holes to use as a handle when removing the camshaft from the block (see illustration).

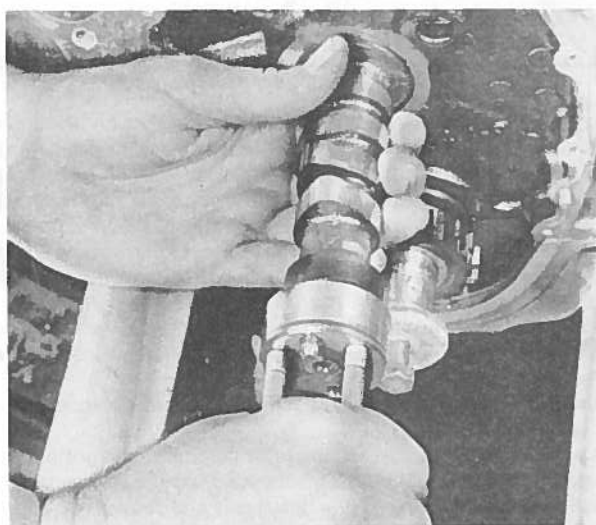
14 Carefully pull the camshaft out. Support the cam near the block so the lobes don't nick or gouge the bearings as it's withdrawn.

### Inspection

15 Inspect the camshaft, bearings and lifters (see Chapter 2, Part C). The illustrations in Part C also pertain to the 4.3L V6 engine.

### Bearing replacement

16 Camshaft bearing replacement requires special tools and expertise that place it outside the scope of the home mechanic. Take the block to an automotive machine shop to ensure that the job is done correctly.



11.13 Long bolts can be threaded into the camshaft bolt holes to provide a handle for removal and installation of the camshaft – support the cam near the block as it's withdrawn

### Installation

Refer to illustration 11.19

17 Lubricate the camshaft bearing journals and cam lobes with moly-base grease or engine assembly lube.

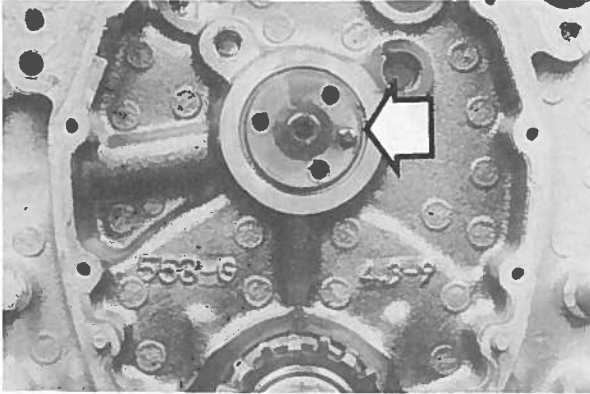
18 Slide the camshaft into the engine. Support the cam near the block and be careful not to scrape or nick the bearings.

19 Turn the camshaft until the dowel pin is in the 3 o'clock position (see illustration).

20 On VIN W engines, install the balancer shaft drive and driven gears (see Section 12).

21 Install the timing chain and sprockets (see Section 10).

22 Lubricate the lifters with clean engine oil and install them in the block. If the original lifters are being reinstalled, be sure to return them to their original locations. (The old lifters can be used even if a new camshaft has been installed, provided they are in good condition).



**11.19** After the camshaft is in place, turn it until the dowel pin (arrow) is in the 3 o'clock position as shown here

- 23 The remaining installation steps are the reverse of removal.  
24 Before starting and running the engine, change the oil and install a new oil filter (see Chapter 1).

## 12 Balancer shaft – removal and installation (1992 and later VIN W engines)

### Removal

- 1 Remove the air cleaner assembly and air intake duct.
- 2 Remove the timing cover, chains and sprockets (see Section 10).
- 3 Remove the hood latch (see Chapter 11).
- 4 Remove the intake manifold (see Section 5).
- 5 Remove the radiator grille and headlight bezels (see Chapter 11).
- 6 Remove the radiator and its support braces, then remove the air conditioning condenser – if equipped – (see Chapter 3).
- 7 Remove the radiator support crossover.
- 8 Remove the retaining stud and the balancer shaft drive gear from the camshaft.
- 9 Remove the retaining bolt and the balancer shaft driven gear.
- 10 Remove the two bolts securing the balancer shaft retainer and remove the retainer.
- 11 Unbolt and remove the lifter retainer (see illustration 11.10a).
- 12 Using a soft-faced mallet, carefully tap the balancer shaft out of the block.

### Inspection

- 13 After the balancer shaft has been removed from the engine, cleaned with solvent and dried, inspect the rear bearing journal for uneven wear, pitting and evidence of seizure. If the journal is damaged, the rear bearing in the block is probably damaged as well. The bearing will have to be replaced.
- 14 Check the balancer drive and driven gears for cracks, missing teeth and excessive wear. If the teeth are highly polished, pitted or galled, or if the outer hardened surface of the teeth is flaking off, new parts will be required. If one gear is worn or damaged, replace both gears as a set. Never install one new gear and one used gear.

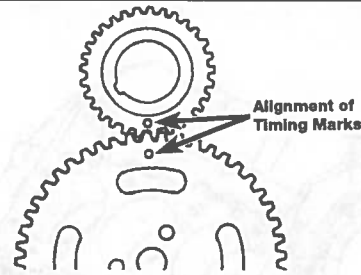
### Bearing replacement

- 15 Balancer shaft bearing replacement requires special tools and expertise that place it outside the scope of the home mechanic. Take the engine block to a dealer service department or an automotive machine shop to ensure that the job is done correctly.

### Installation

Refer to illustration 12.22

- 16 Lubricate the balancer shaft bearing journals with moly-base grease or engine assembly lube.
- 17 Slide the balancer shaft into the engine. Support the balancer near the block and be careful not to scrape or nick the bearing. It may be necessary to gently tap on the shaft with a soft-face mallet.
- 18 Install the balance shaft retainer and two bolts and tighten them to the



**12.22** Make sure the balancer shaft timing marks on both the drive and driven gears are aligned

torque listed in this Chapter's Specifications.

- 19 Install the lifter retainer and bolts, then tighten the bolts securely.
- 20 Rotate the balancer shaft by hand to make sure there is sufficient clearance between the balancer shaft and the lifter retainer. Replace the lifter retainer if necessary.
- 21 Install the balancer shaft driven gear and tighten the bolt to the torque listed in this Chapter's Specifications.
- 22 Rotate the camshaft so that, with the drive gear temporarily installed, the timing mark is straight up at the 12 o'clock position (see illustration). Remove the drive gear.
- 23 Rotate the balancer shaft until the timing mark is facing straight down at the 6 o'clock position (see illustration 12.22).
- 24 Install the balancer drive gear onto the camshaft and install the retaining stud, then tighten it to the torque listed in this Chapter's Specifications.
- 25 Install the timing chain, sprockets and cover (see Section 10).

## 13 Oil pan – removal and installation

Refer to illustration 13.5

**Note:** On 2WD models it is necessary to remove the engine from the vehicle to perform this procedure (see Chapter 2F). On 4WD models, the front differential housing must be unbolted, moved forward and supported (see Chapter 8) and the engine must be unbolted from the mounts and raised with an engine hoist to provide the necessary clearance for oil pan removal.

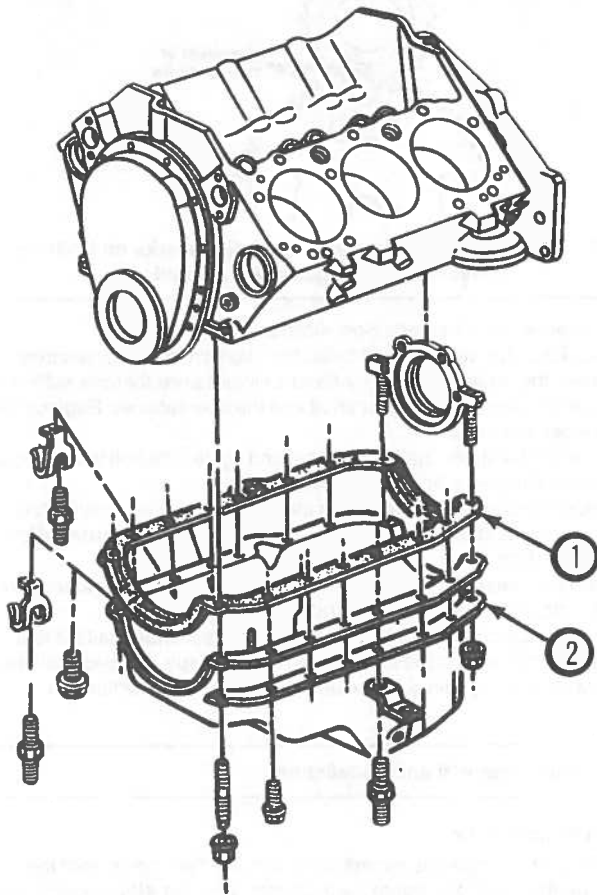
### Removal

- 1 Disconnect the negative battery cable from the battery, then refer to Chapter 1 and drain the oil.
- 2 Remove the starter motor (see Chapter 5).
- 3 Remove the cover from the lower part of the bellhousing.
- 4 Separate the exhaust pipes from the manifolds, if not already done.
- 5 Remove the oil pan mounting bolts/nuts. Most models are equipped with a reinforcement strip on each side of the oil pan which may come loose after the bolts/nuts are removed (see illustration).
- 6 Carefully separate the pan from the block. Don't pry between the block and pan or damage to the sealing surfaces may result and oil leaks could develop. You may have to turn the crankshaft slightly to maneuver the front of the pan past the crank counterweights.

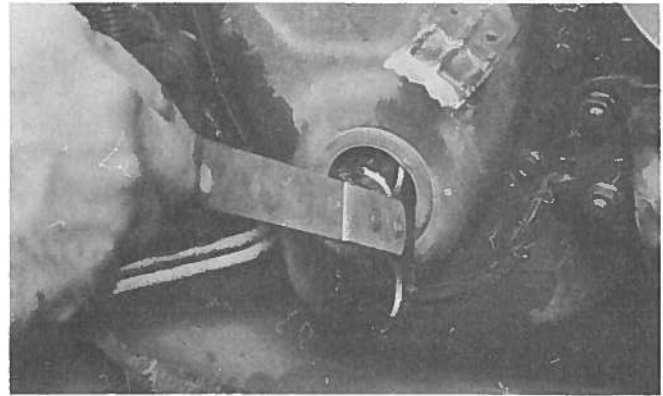
### Installation

- 7 Clean the gasket sealing surfaces with lacquer thinner or acetone. Make sure the bolt holes in the block are clean.
- 8 Check the oil pan flange for distortion, particularly around the bolt holes. If necessary, place the pan on a block of wood and use a hammer to flatten and restore the gasket surface.
- 9 The rubber gasket should be checked carefully and replaced with a new one if damage is noted. Apply a small amount of RTV sealant to the corners of the semi-circular cutouts at both ends of the pan, then attach the rubber gasket to the pan.
- 10 Carefully position the pan against the block and install the bolts/nuts finger tight (don't forget the reinforcement strips, if used). Tighten the bolts/nuts in three steps to the torque listed in this Chapter's Specifications. Start at the center of the pan and work out toward the ends in a spiral pattern.

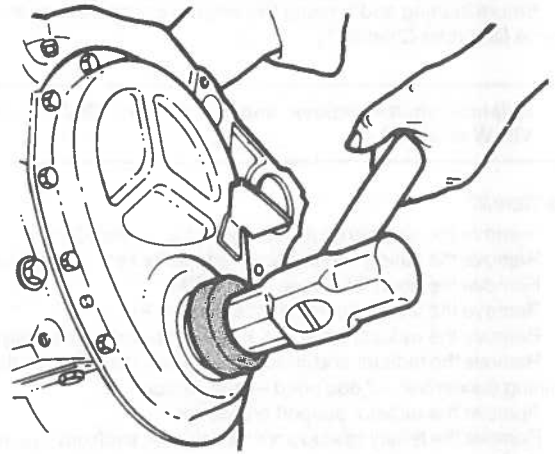




13.5 The gasket (1) is a one-piece molded rubber part and reinforcement strips (2) are used on each side of the oil pan



15.2 The crankshaft front oil seal can be removed in the vehicle with a seal removal tool (shown here) or a large screwdriver



15.4 Installing the front crankshaft oil seal using GM tool no. J-23042A

- 11 The remaining steps are the reverse of removal. **Caution:** Don't forget to refill the engine with oil before starting it (see Chapter 1).
- 12 Start the engine and check carefully for oil leaks at the oil pan.

#### 14 Oil pump - removal and installation

- 1 Remove the oil pan (see Section 12).
- 2 While supporting the oil pump, remove the pump-to-rear main bearing cap bolt. On some models, the oil pan baffle must be removed first, since it's also held in place by the pump mounting bolt.
- 3 Lower the pump and remove it along with the pump driveshaft.
- 4 If a new oil pump is installed, make sure the pump driveshaft is mated with the shaft inside the pump.
- 5 Position the pump on the engine and make sure the slot in the upper end of the driveshaft is aligned with the tang on the lower end of the distributor shaft. The distributor drives the oil pump, so it is absolutely essential that the components mate properly.
- 6 Install the mounting bolt and tighten it to the torque listed in this Chapter's Specifications.
- 7 Install the oil pan.

#### 15 Crankshaft oil seals - replacement

##### Front seal - timing chain cover in place

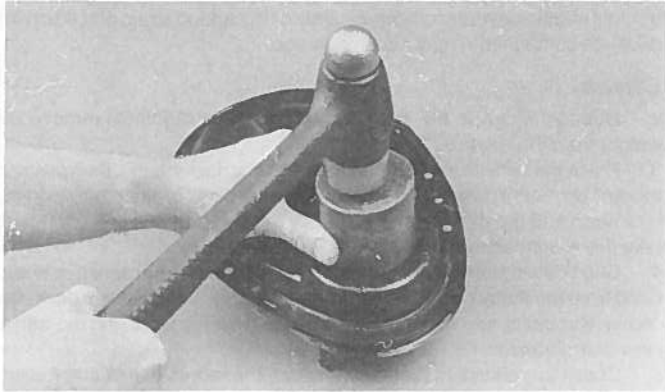
Refer to illustrations 15.2 and 15.4

- 1 Remove the vibration damper (see Section 10).



15.6 While supporting the cover near the seal bore, drive the old seal out from the inside with a hammer and punch or screwdriver

- 2 Carefully pry the seal out of the cover with a seal removal tool or a large screwdriver (see illustration). Be careful not to distort the cover or scratch the wall of the seal bore. If the engine has accumulated a lot of miles, apply penetrating oil to the seal-to-cover joint and allow it to soak in before attempting to pull the seal out.
- 3 Clean the bore to remove any old seal material and corrosion. Position the new seal in the bore with the open end of the seal facing IN. A small amount of oil applied to the outer edge of the new seal will make installation easier.
- 4 Apply a light film of grease to the lip of the seal. Drive the seal into the bore with GM tool no. J-23042A or a large socket and hammer until it's completely seated (see illustration). Select a socket that's the same out



**15.8** Clean the bore, then apply a small amount of oil to the outer edge of the seal and drive it squarely into the opening with a large socket and hammer – DO NOT damage the seal in the process!

side diameter as the seal (a section of pipe can be used if a socket isn't available).

5 Reinstall the vibration damper.

### Front seal – timing chain cover removed

Refer to illustrations 15.6 and 15.8

6 Use a punch or screwdriver and hammer to drive the seal out of the cover from the back side. Support the cover as close to the seal bore as possible (see illustration). Be careful not to distort the cover or scratch the wall of the seal bore. If the engine has accumulated a lot of miles, apply penetrating oil to the seal-to-cover joint on each side and allow it to soak in

before attempting to drive the seal out.

7 Clean the bore to remove any old seal material and corrosion. Support the cover on blocks of wood and position the new seal in the bore with the open end of the seal facing IN. A small amount of oil applied to the outer edge of the new seal will make installation easier.

8 Drive the seal into the bore with a large socket and hammer until it's completely seated (see illustration). Select a socket that's the same outside diameter as the seal (a section of pipe can be used if a socket isn't available). Install the timing chain cover.

### Rear main oil seal

Refer to illustrations 15.10, 15.12 and 15.13

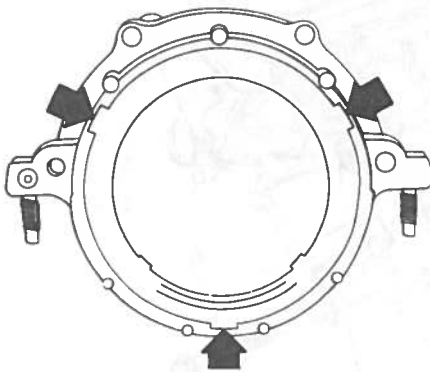
9 Remove the transmission (see Chapter 7).

10 The old seal can be removed from the housing by inserting a large screwdriver into the notches provided and prying it out (see illustration). Be sure to note how far it's recessed into the housing bore before removing it; the new seal will have to be recessed an equal amount. Be very careful not to scratch or otherwise damage the bore in the housing or oil leaks could develop.

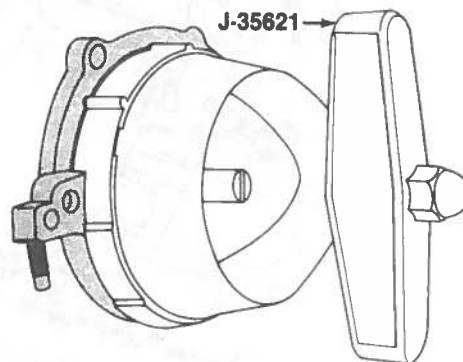
11 Check the seal contact surface very carefully for scratches and nicks that could damage the new seal lip and cause oil leaks. If the crankshaft is damaged, the only alternative is a new or different crankshaft.

12 Make sure the housing is clean, then apply a thin coat of engine oil to the outer edge of the new seal. Apply multi-purpose grease to the seal lips. The seal must be pressed squarely into the housing bore, so hammering it into place is not recommended. If you don't have access to GM tool no. J-35621 (see illustration), unbolt the seal housing from the block. Sandwich the housing and seal between two smooth pieces of wood and press the seal into place with the jaws of a large vise. The pieces of wood must be thick enough to distribute the force evenly around the entire circumference of the seal. Work slowly and make sure the seal enters the bore squarely.

2E



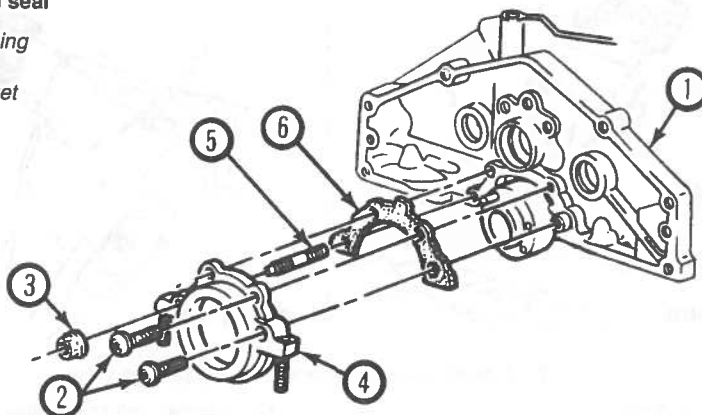
**15.10** To remove the rear main seal from the housing, insert the tip of the screwdriver into each notch (arrows) and pry the seal out



**15.12** GM tool no. J-35621 is recommended for seal installation with the housing attached to the engine

### 15.13 Details of the rear main oil seal

- |   |               |   |         |
|---|---------------|---|---------|
| 1 | Rear of block | 4 | Housing |
| 2 | Screw         | 5 | Stud    |
| 3 | Nut           | 6 | Gasket  |



- 13 The seal lips must be lubricated with clean engine oil or multi-purpose grease before the seal/housing is slipped over the crankshaft and bolted to the block. Use a new gasket – no sealant is required – and make sure the dowel pins are in place before installing the housing (see illustration).  
 14 Tighten the nuts/screws a little at a time until they're all snug.

#### 16 Flywheel/driveplate – removal and installation

- 1 Remove the transmission (see Chapter 7). If your vehicle has a manual transmission, remove the pressure plate and clutch (see Chapter 8).
- 2 Jam a large screwdriver in the starter ring gear to keep the crankshaft from turning, then remove the mounting bolts. Since it's fairly heavy, support the flywheel as the last bolt is removed.
- 3 Pull straight back on the flywheel/driveplate to detach it from the crankshaft.
- 4 Installation is the reverse of removal. The driveplate must be mounted with the torque converter pads facing the transmission. Be sure to align the hole in the flywheel/driveplate with the dowel pin in the crankshaft. Use Loctite on the bolt threads and tighten them to the torque listed in this Chapter's Specifications in a criss-cross pattern.

#### 17 Engine mounts – check and replacement

Refer to illustration 17.7

- 1 Engine mounts seldom require attention, but broken or deteriorated

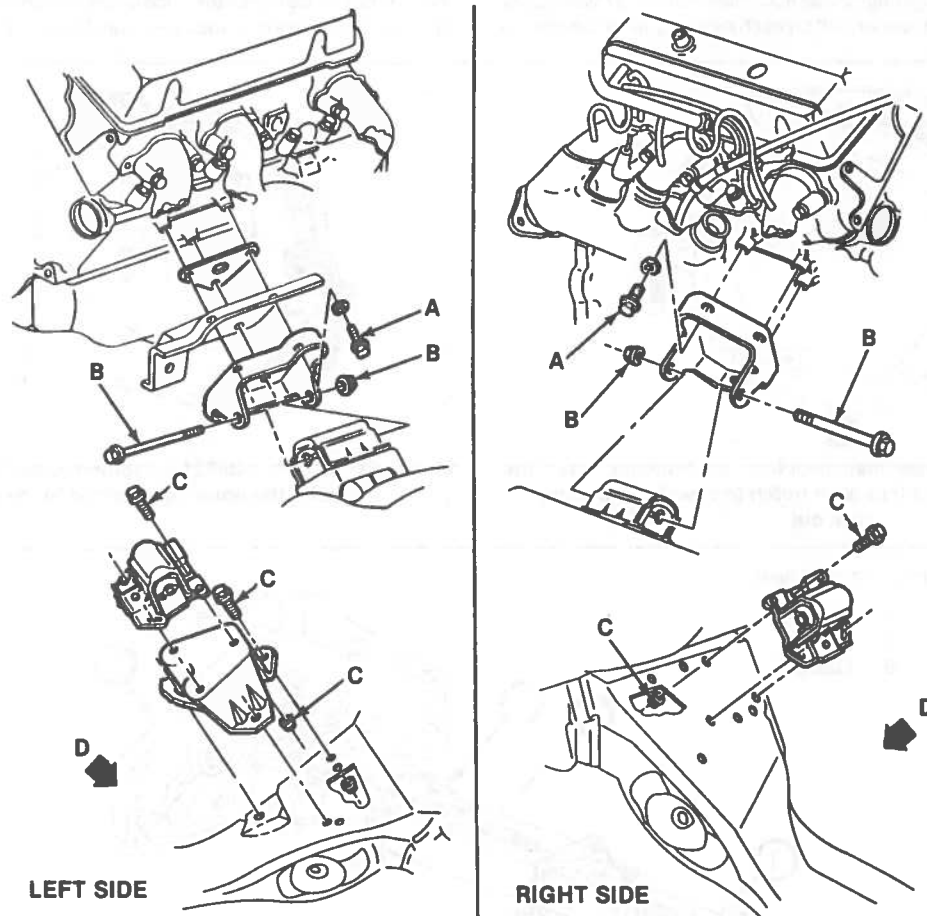
mounts should be replaced immediately or the added strain placed on the driveline components may cause damage.

#### Check

- 2 During the check, the engine must be raised slightly to remove the weight from the mounts.
- 3 Raise the vehicle and support it securely on jackstands, then position the jack under the engine oil pan. Place a large block of wood between the jack head and the oil pan, then carefully raise the engine just enough to take the weight off the mounts.
- 4 Check the mounts to see if the rubber is cracked, hardened or separated from the metal plates. Sometimes the rubber will split right down the center. Rubber preservative or WD-40 should be applied to the mounts to slow deterioration.
- 5 Check for relative movement between the mount plates and the engine or frame (use a large screwdriver or pry bar to attempt to move the mounts). If movement is noted, lower the engine and tighten the mount fasteners.

#### Replacement

- 6 Disconnect the negative battery cable from the battery, then raise the vehicle and support it securely on jackstands.
- 7 Remove the nut and withdraw the mount through bolt from the frame bracket (see illustration).
- 8 Raise the engine slightly, then remove the mount-to-block bolts and detach the mount.
- 9 Installation is the reverse of removal. Use Loctite on the mount bolts and be sure to tighten them securely.



17.7 Engine mount components – exploded view

- |                                               |                                               |
|-----------------------------------------------|-----------------------------------------------|
| A 36 ft-lbs                                   | C Tighten bolt to 45 ft-lbs, nut to 36 ft-lbs |
| B Tighten bolt to 75 ft-lbs, nut to 50 ft-lbs | D Forward                                     |